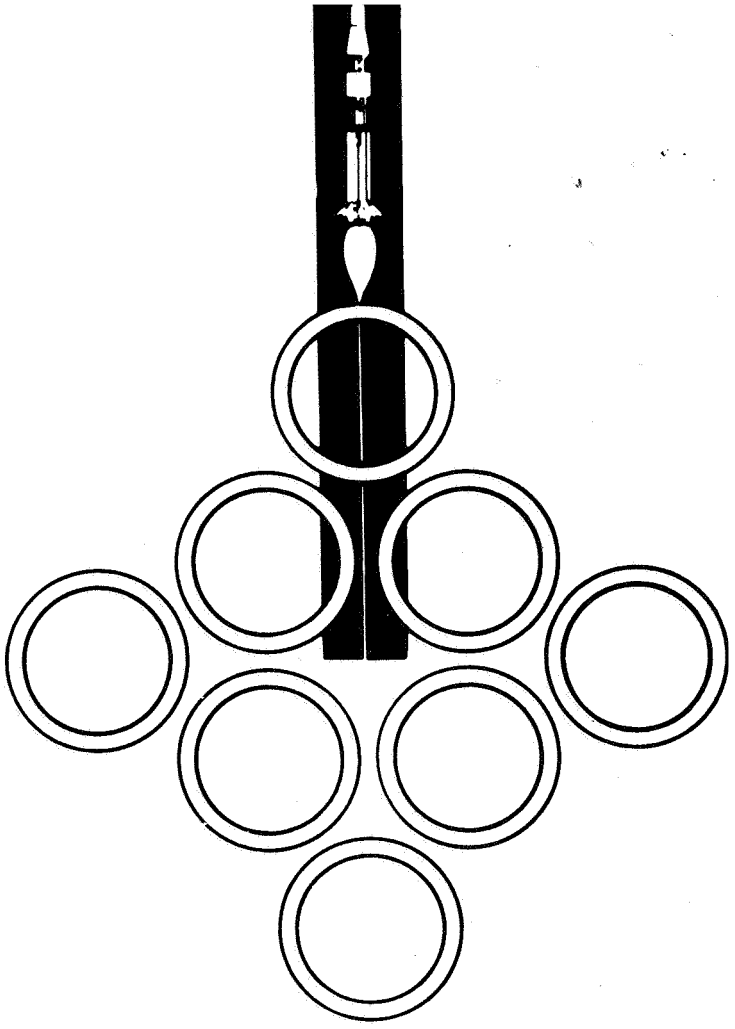


ENGINEERING DEPARTMENT

TECHNICAL REPORT

TR-RE-CCSD-FO-1111-3

March 24, 1967

SATURN IB PROGRAM

N67-36089
(ACCESSION NUMBER)
(PAGES)
(NASA CR OR TMX OR AD NUMBER)
(THRU)
(CODE)
(CATEGORY)
FACILITY FORM 602

TEST REPORT

FOR

CHECK VALVE, 2-INCH, 6000-PSIG

The Annin Co. Drawing Number A5094

NASA Drawing Number 75M14693 PCV-1

SPACE DIVISION CHRYSLER CORPORATION

TEST REPORT

FOR

CHECK VALVE, 2-INCH, 6000-PSIG

The Annin Co. Drawing Number *A5094*

NASA Drawing Number 75M14963 PCV-1

ABSTRACT

This report presents the results of tests performed on one sample of 2-Inch Check Valve 75M14693 PCV-1. The following tests were performed:

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Flow
5. Surge
6. Low Temperature
7. High Temperature
8. Cycle
9. Burst

The specimen failed to meet the test requirements of the John F. Kennedy Space Center.

The following failures and discrepancies were revealed during testing:

a. Receiving Inspection

A weld burn deposit was revealed inside the inlet port but it did not impair the specimen performance.

b. Flow Test

The specimen does not meet the minimum C_V requirement. The specimen failed the leakage tests following flow due to seat wear and leakage.

c. Cycle Test

The specimen cracking pressure increased as the number of cycles increased. On completion of the cycle test the specimen was disassembled and the poppett (ss) and poppett bushing (bronze) were found to be scored and binding.

d. Burst Test

The specimen failed at 21,500 psig due to seal failure.

TEST REPORT

FOR

CHECK VALVE, 2-INCH, 6000-PSIG,

The Annin Co. Drawing Number A5094,

NASA Drawing Number 75M14693 PCV-1

March 24, 1967

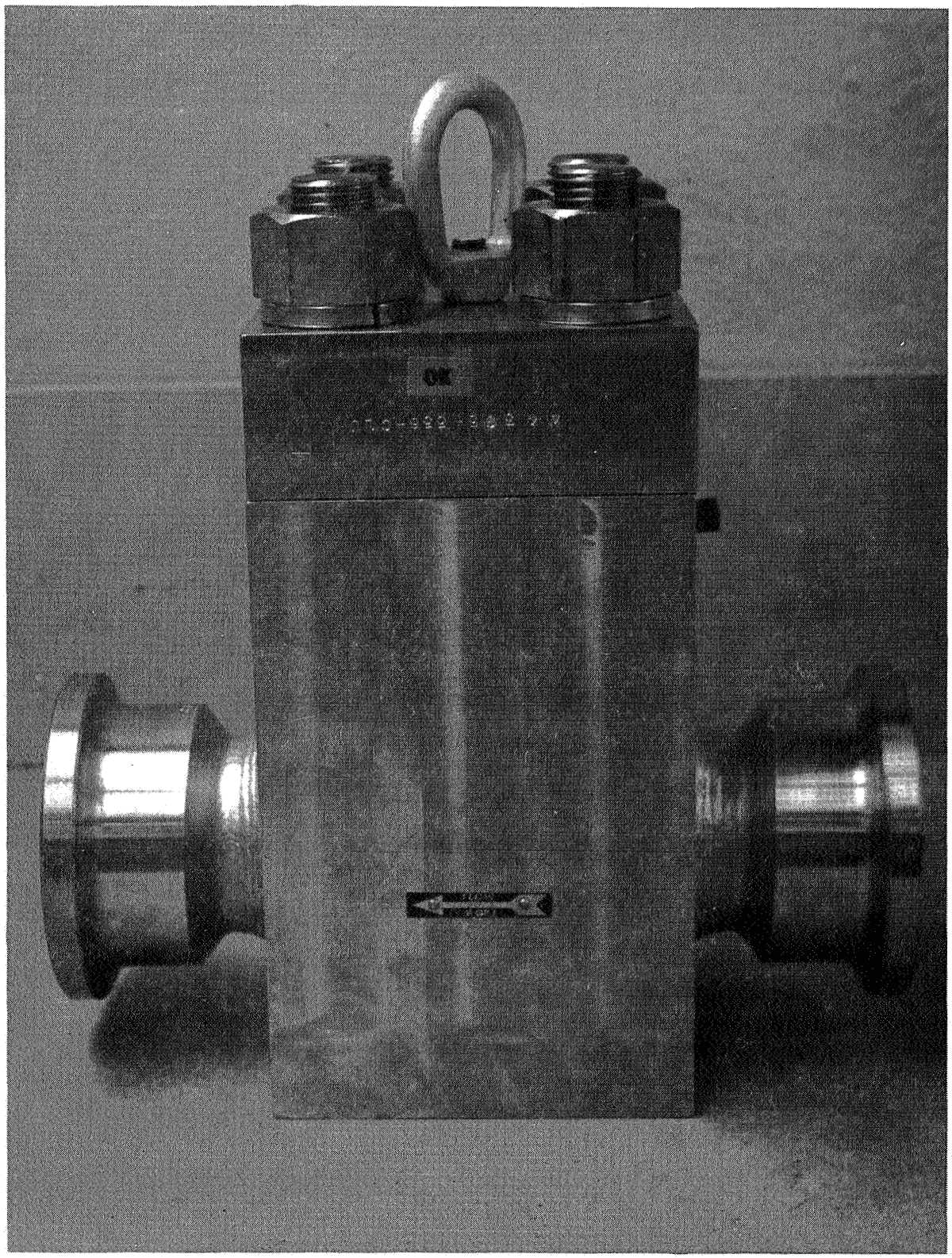
FOREWORD

The tests reported herein were conducted for the John F. Kennedy Space Center by Chrysler Corporation Space Division (CCSD), New Orleans, Louisiana. This document was prepared by CCSD under contract NAS8-40016, Part VII, CWO 271620.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES



Check Valve 75M14963 PCV-1, 2-Inch ID, *6000* Psig

CHECK SHEET

FOR

2 INCH, 6000-PSIG CHECK VALVE

MANUFACTURER: The Annin Co.
MANUFACTURERS DRAWING NUMBER: A5094
NASA DRAWING NUMBER: 75M14963 PCV-1
TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, La.
AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A.	OPERATING MEDIUM:	Helium, nitrogen, and air
B.	CRACKING PRESSURE:	150-psig maximum
C.	VALVE CAPACITY:	C_v - 4.7 minimum (determined by test)
D.	VALVE LEAKAGE:	Internal - none External - none
E.	PROOF PRESSURE:	9000-psig

II. CONSTRUCTION

A.	MATERIAL:	The valve body, connections, stem, plug, and bolting material shall be of type 316 stainless steel. The seals and packing will be of teflon, and the seat will be teflon or Kel-F.
B.	CONNECTIONS:	2½-inch Grayloc

III. ENVIRONMENTAL REQUIREMENTS

A. OPERATING TEMPERATURE RANGE:

-20 to +160°F

IV. LOCATION AND USE

A. The valve is used as a check valve in the high pressure pneumatic system of Launch Complex 34.

TEST SUMMARY

FOR

CHECK VALVE, 2-INCH, 6000-PSIG

75M14963 PCV-1

ENVIRONMENT	UNITS	OPERATIONAL BOUNDARY	TEST OBJECTIVE	TEST RESULTS	REMARKS
Receiving Inspection	1	Visual Examination	To determine if specimen conforms with applicable drawings and specifications	Satisfactory	Weld burn deposit revealed but wasn't impairitive
Proof Pressure Test	1	9000 psig for 5 minutes	Maintain 9000 psig	Satisfactory	Maintained 9000 psig. No leakage
Functional Test	1		To determine cracking and reseating pressure	Satisfactory	Cracking pressure-136-psig Reseat pressure - 77-psig
Flow Test	1	Minimum C_v shall be 22.0	Determine C_v for the valve	Unsatisfactory	Minimun C_v 4.7 Specimen failed post flow functional test
Surge Test	1	Zero to 6000 psig pressure within 100 milliseconds for 25 cycles in both directions	Determine performance of specimen in rapidly changing pressure environment	Satisfactory	Pressurization time between 80 and 90 milliseconds
Low Temperature Test	1	Stabilize specimen at 20 F, perform a functional test at low temperature and after return to ambient conditions	Determine operating capability at low temperature and after return to ambient conditions	Satisfactory	No leakage in pressure test

TEST SUMMARY **(Continued)**

ENVIRONMENT	UNITS	OPERATIONAL BOUNDARY	TEST OBJECTIVE	TEST RESULTS	REMARKS
High Temperature Test	1	Stabilize specimen at 160 F for 72 hours, perform a functional test at high temperature and after return to ambient conditions.	Determine operating capability at high temperature and after return to ambient conditions	Satisfactory	No leakage in pressure test
Cycle Test	1	Zero to 6000 psig pressure then to zero. Perform 1000 cycles	Perform a functional test after 50,100,500, and 1000 cycles. Check for leakage.	Unsatisfactory	Specimen failed functional test after 1000 cycles, due to lack of poppet lubrication.
Burst Test	1	24,000 psig for 5 minutes	Maintain 24,000 psig with no leakage for 5 minutes	Unsatisfactory	Specimen seals failed at 21,500 psig

SECTION I

INTRODUCTION

1.1 SCOPE

This report presents the results of tests that were performed to determine if Check Valve 75M14693 PCV-1 meets the operational requirements of the John F. Kennedy Space Center Launch Complex 34. A summary of the test results is presented on pages viii and ix.

1.2 ITEM DESCRIPTION

Check Valve 75M14693 PCV-1 is a 2-inch check valve with $2\frac{1}{2}$-inch extra strong Grayloc hub inlet and outlet connections. The valve is of the lift check type and is designed to operate at 6,000 psig in a gaseous medium. Its temperature application is in the range of -20 to +160°F. The valve requires a maximum cracking pressure of 150 psig and has a minimum C_v of 4.7 (determined by test).

1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for check valve 75M14963 PCV-1.

a. KSC-STD-164(D), Standard Environmental Test Methods for Ground Support Equipment Installations at Cape Kennedy.

b. Drawing 75M14963 PCV-1, Valve, Check

c. MFSC-STD-164, Cleaning Standard

d. Test Plan CCSD-FO-1111-1F

e. Test Procedure CCSD FO 1111-2F

Figure 2-2. Receiving Inspection Discrepancy

SECTION II

RECEIVING INSPECTION

2.1 TEST REQUIREMENTS

The specimen shall be visually and dimensionally inspected for conformance with the applicable specifications prior to testing.

2.2 TEST PROCEDURE

A visual and dimensional inspection was performed to determine compliance with NASA drawing 75M14963 PCV-1 and the applicable vendor drawing to the extent possible without disassembly of the test specimen. At the same time the test specimen was also inspected for poor workmanship and manufacturing defects.

2.3 TEST RESULTS

The receiving inspection (Visual) test revealed a weld burn deposit inside the inlet port of the test specimen. However, the weld deposit did not impair the performance of the specimen.

2.4 TEST. DATA

The data presented in table 2-l were recorded during the inspection.

Table 2-1. Specimen Specifies

Model	A 5094
Serial No.	62554-1-1
Length	12 ½-inches
Hub Size	2 ½ inches Grayloc XX

SECTION III

PROOF PRESSURE TEST

3.1 TEST REQUIREMENTS

3.1.1 The test specimen shall he hydrostatically pressurized to 9000 psig for 5 minutes.

3.1.2 The test specimen shall bo inspected for leakage and distortion.

3.2 TEST PROCEDURE

3.2.1 The test setup was assenbled as shown in figures 3-1 and 3-2 using the equipment listed in table 3-1. All hand valves were closed.

3.2.2 Hand valve 4 and 6 were opened. Hand Pump 3 was operated to purge the system and specimen of air.

3.2.3 Hand valve 6 was closed and the specimen was pressurized to 9000 psig using hand pump 3. The pressure indicated on gage 5 was monitored.

3.2.4 Hand valve 4 was closed and the pressure was maintained for 5 minutes.

3.2.5 The specimen was checked for leakage during this 5 -minute period by monitoring gage 5 for an indication of a pressure drop at the specimen. The initial and final pressures were recorded.

3.2.6 Valves 4 and 6 were opened and the system and specimen were depressurized.

3.2.7 The specimen was removed from the test setup and inspected for distortion.

3.3 TEST RESULTS

There was no leakage of the test specimen, and no distortion was evident.

3.4 TEST DATA

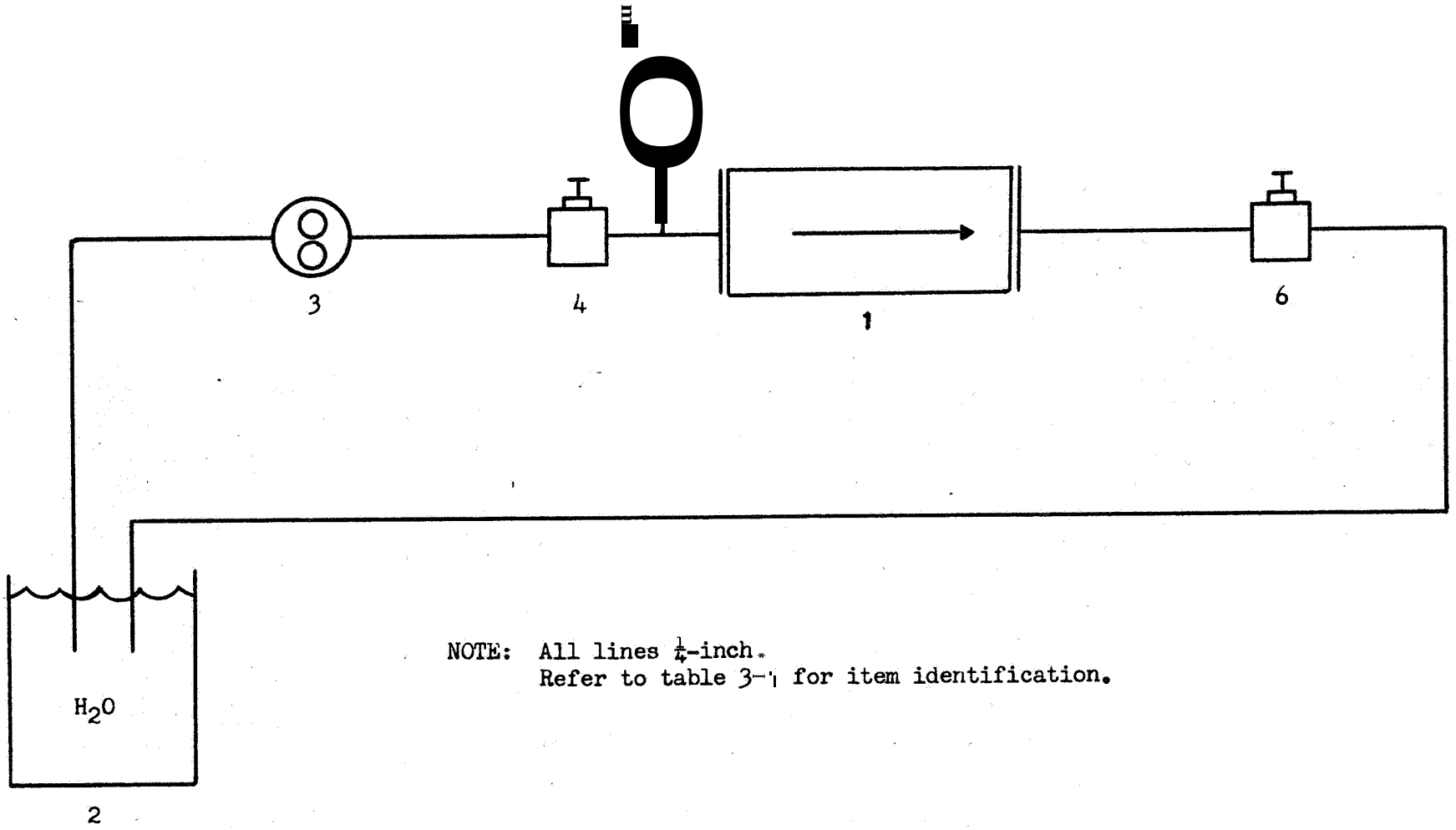
The test data presented in table 3-2 were recorded during the test.

Table 3-1. **Proof Pressure** Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial NO.	Remarks
1	Test **Specimen**	Annin co.	A5094	62554-1	2-inch, 6000-psig check valve
2	Reservoir	CCSD	NA	NA	H_2O
3	**Hand** Pump	Sprague **Eng.** Corp.		300-16-6	0-to **30,000-psig**
4	**Hand** Valve	**Aminco**	50011A	NA	¼-inch **bar .stock**
5	Pressure Gage	Ashcroft		95-1395B	0-to 10,000-psig ±0.5% FS Cal date 11-4-66
6	Hand Valve	**Aminco**	50011A	NA	¼-inch bar stock

Table 3-2. Proof **Pressure** Test Data

Pressure	9000 psig for 5 **minutes**
Leakage	None
Distort**ion**	None



NOTE: All lines ¼-inch.
Refer to table 3-1 for item identification.

Figure 3-1. Proof Pressure Test Schematic

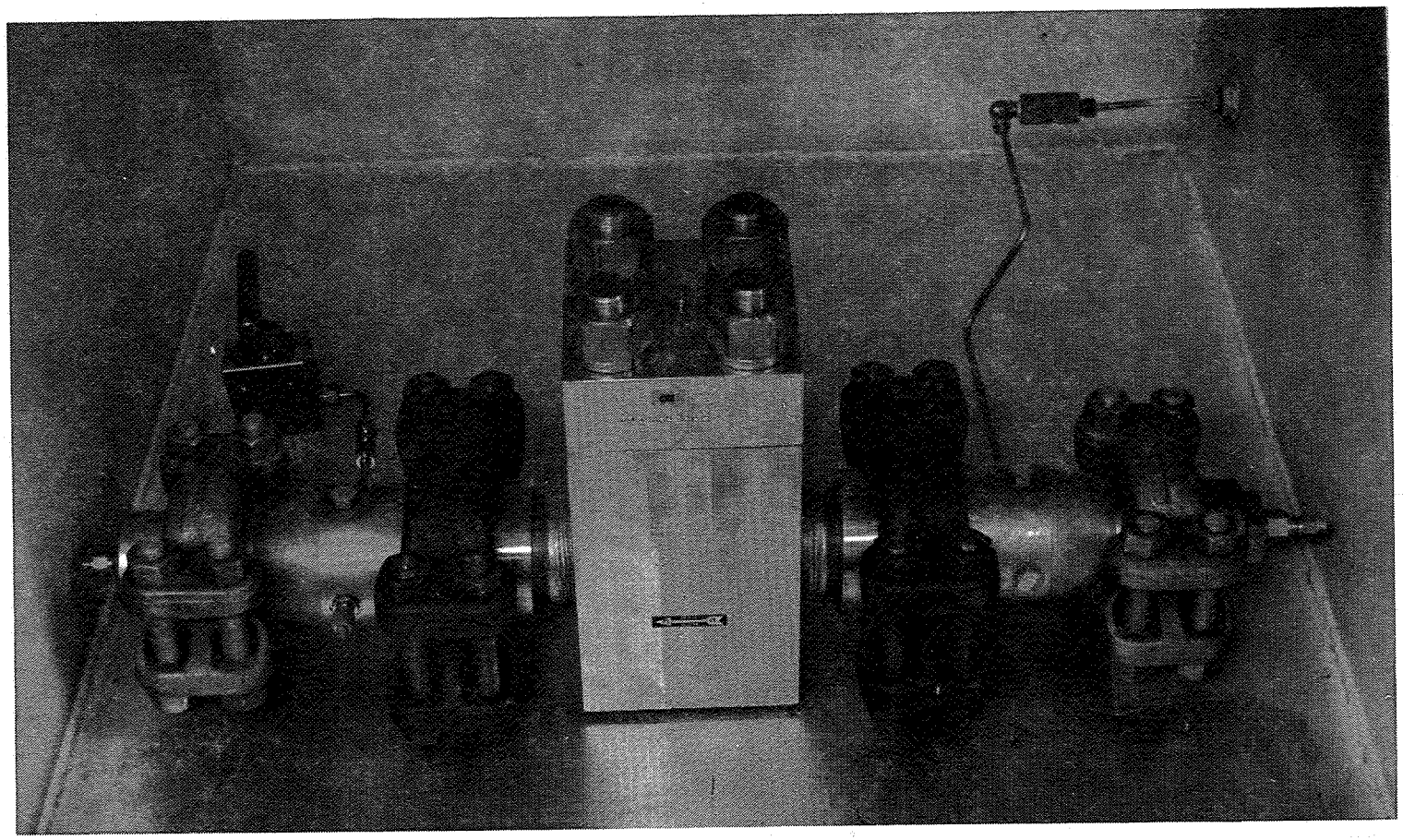


Figure 3-2. Proof Pressure Test Setup

SECTION IV

FUNCTIONAL TEST

4.1 TEST REQUIREMENTS

4.1.1 The test specimen shall be inspected for internal leakage at 6000 psig for 5 minutes. No leakage is allowed.

4.1.2 The cracking and reseating pressures of the test specimen shall be determined using GHe as the test medium.

4.2 TEST PROCEDURE

4.2.1 The test was assembled as shown in figures 4-1A and 4-2 using the equipment listed in table 4-1. A section of 1/8 inch tubing, 12 inches in length was connected to the outlet port of the specimen. Beaker 11 was filled with water and the full end of the tubing was placed in the beaker.

402.2 It was determined that all connections were tight, all gapes were installed and operating properly. Regulator 7 and all hand valves were closed.

4.2.3 Hand valve 4 was opened and control valve 8 was cracked. Regulator 7 was adjusted until bubbles appeared in beaker 11. The cracking pressure readinp of gage 10 was recorded,

4.2.3.1 Regulator 7 was closed; the reseating pressure reading of gage 10 was recorded when bubbles no longer appeared in beaker 11.

4.2.3.2 Hand valve 9 was opened until gape 10 indicated zero psig. Hand valve 4, regulator 7, control valve 8, and hand valve 9 were closed in that sequence.

4.2.4 The specimen was installed as shown in figure 4-1B. Gage 10A replaced gage 10.

4.2.4.1 Hand valve 4 and control valve. 8 were opened. The outlet port of the specimen was pressurized to 6000 psig by adjusting regulator 7. The pressure was monitored on gage 10A.

4.2.4.2 The specimen was checked for internal leakage by observing beaker 11 for the presence of bubbles.

4.2.5 Hand valve 4 was closed and the system was vented by openinp hand valve 9.

4.3 TEST RESULTS

4.3.1 The functional test was performed and the cracking and reseat pressure was determined. Specimen successfully passed the functional test.

4.4 TEST DATA

4.4.1 Data recorded during the functional test are presented in table 4-2.

Table 4–1. Functional Test Equipment List

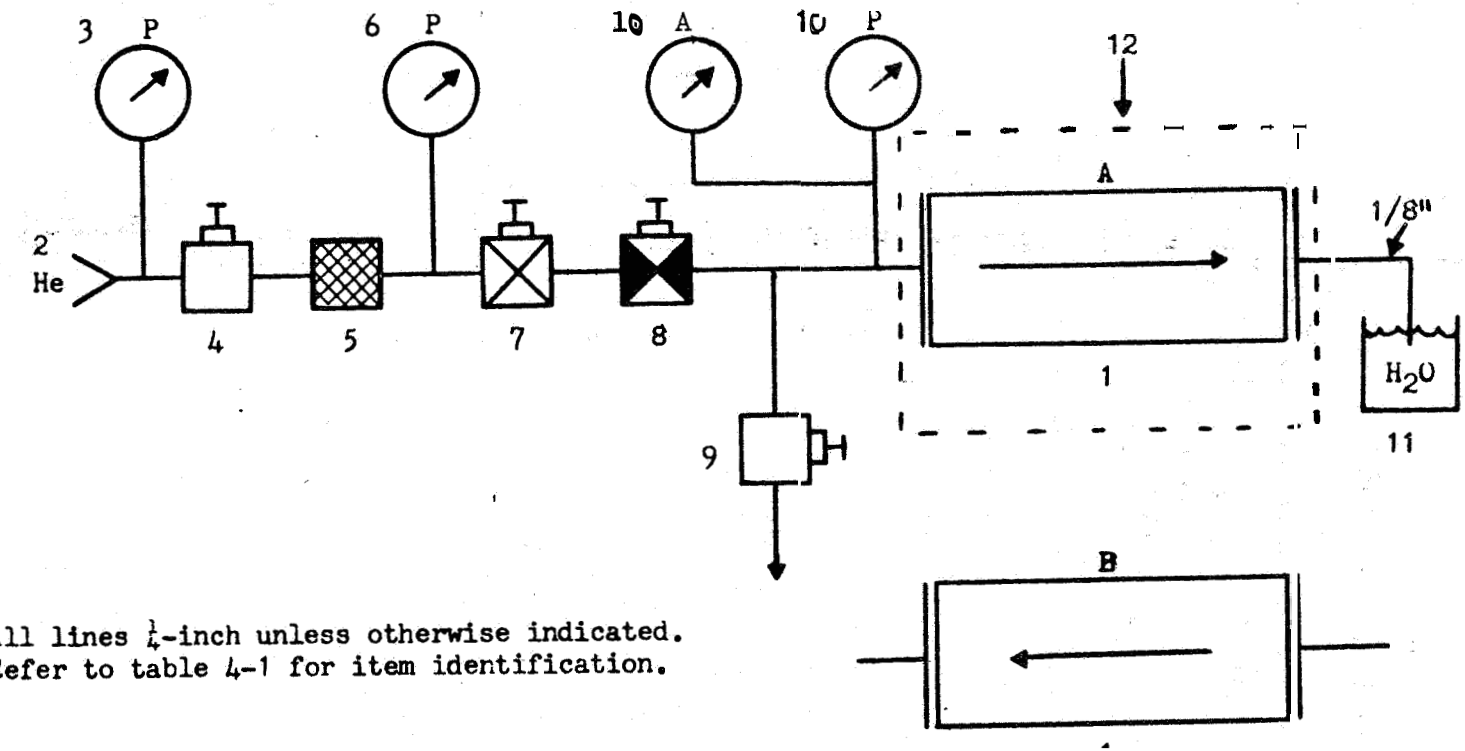
Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Annin Co.	A5094	62554–1	2,–inch, 6000 psig check valve
2	Pressure Source		N/A	N/A	He 0 to 10,ooopsig
3	Pressure Gage	Heise	P13527	012452	0 to 10,000psig ± 0.1% FS Cal Date 12–15–66
4	Hapd Valve	Robbins Aviation	SSKG 250–4T	N/A	1/4 inch bar stock
5	Filter	Fluid Dynamics	FL02–888	4066	10 micron
6	Pressure Gage	Ashcroft	L850	91647	0 to 10,000psig ± 0.5% FS Cal Date 12–15–66
7	Pressure Regulator	Tescom	26–10224	8360	0 to 10,000psig Lnlet 0 to 10,000psig outlet
8	Control Valve	Robbins Aviation	SSKG–250–4T	N/A	1/4 inch bar stock
9	Hand Valve	Robbins Aviation	SSKG–250–4T	N/A	1/4 inch bar stock
10	Pressure Gage	Ashcroft	200–694 AA		0–300 psig ± 0.5% FS Cal Date 3–9–66
10A	Pressure Gage	Ashcroft	1850	95–1648	3–10,000 psig ± 0.5% FS Cal Date 12–15–66
11	Beaker	Pyrex	GL100	N/A	100 cc
*12	Temperature Chamber	Conrad	N/A	200922	–20 to +200°F

* Equipment used during temperature test only.

Table 4-2. Functional Test Results

CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	109	78
2	6,000	NONE	145	75
3	6,000	NONE	145	85
4	6,000	NONE	145	70

Note: All pressure readings are in psig



NOTE: All lines ¼-inch unless otherwise indicated.
Refer to table 4-1 for item identification.

Figure 4-1. Functional Test Schematic

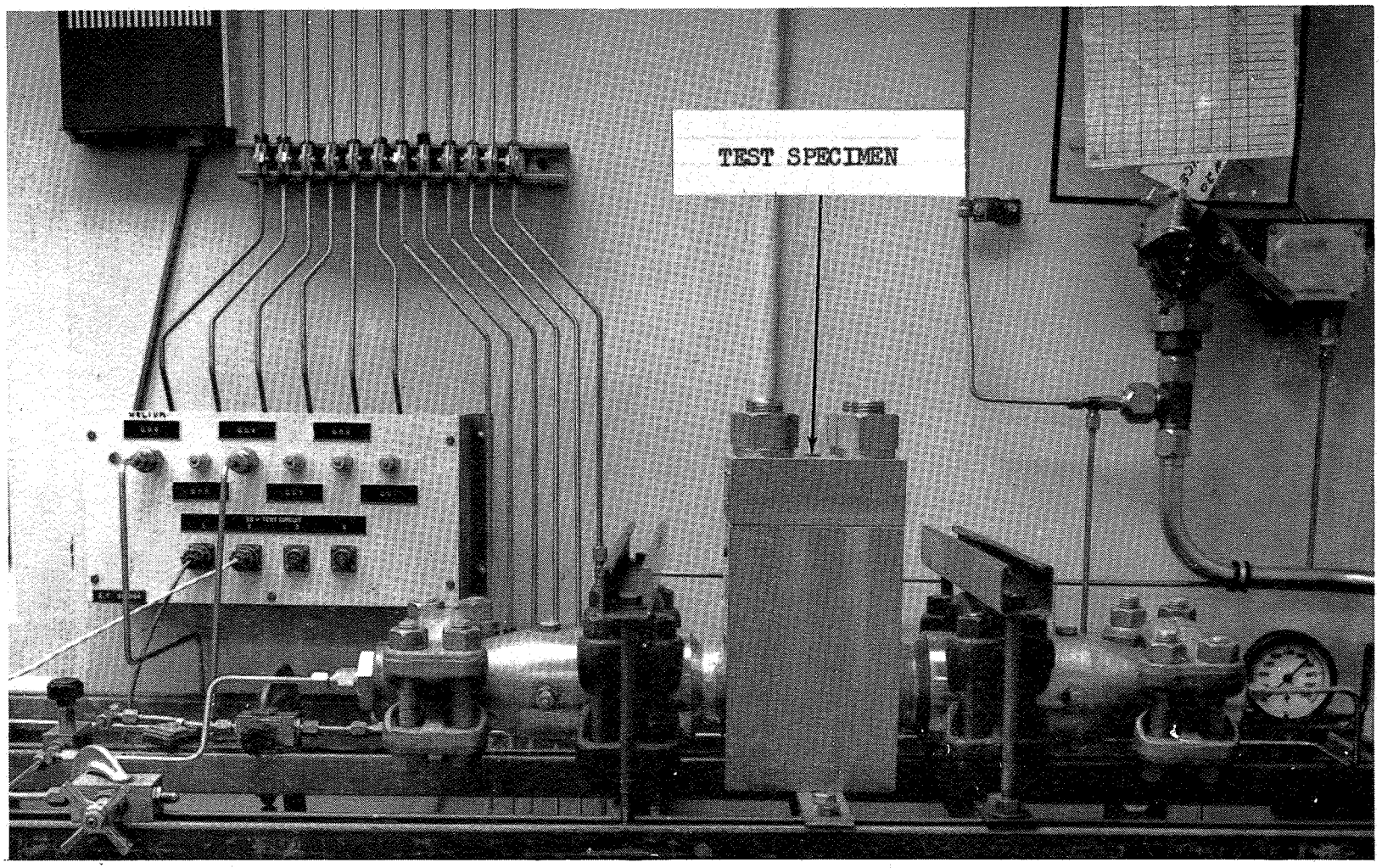


Figure 4-2. Functional Test Setup

SECTION V

FLOW TEST

5.1 TEST REQUIREMENTS

5.1.1 The valve capacity (Cv) of the test specimen shall. be determined by performing a flow test. Minimum Cv shall be 22.0.

5.1.2 Water shall be used as the test medium.

5.2 TEST PROCEDURE

5.2.1 The test setup was assembled as shown in figure 5-1 utilizing the equipment listed in table 5-1. All hand valves were closed.

5.2.2 Hand valve 3 was closed and reservoir vent valve 11 was opened. Hand valve 14 was opened and reservoir 10 was filled to approximately 75 percent of its capacity.

5.2.3 Hand valves 11 and 14 were closed.

5.2.4 Hand valve 3 was opened and regulator 6 was adjusted so that 1200 psig pressure was placed in the reservoir. The pressure was monitored on gage 16.

5.2.5 Regulators 17 and 18 were adjusted so that flow rates of 50 through 88 gallons per minute were attained as indicated by differential pressure gage 20. The pressure drop across the valve and the pipe loss were read on gages 22, 23, and 24 and were recorded. The water temperature as indicated by pyrometer 26 was recorded.

5.2.6 Using data obtained from the flow test a graph of the differential pressure versus flow rate was plotted.

5.2.6.1 The valve capacity (Cv) of the specimen was calculated using the formula

$$cv = V\sqrt{\frac{G}{\Delta P}}$$

Where V equals the flow rate in gpm, G equals the specific gravity at flow temperature of the test medium, and A P equals the pressure drop across the specimen in psi.

5.3 TEST RESULTS

5.3.1 The minimum C_v of the specimen was 4.7.

5.3.2 The specimen failed the post flow functional test due to specimen seat failure.

5.3.3 The specimen was disassembled and new seals were installed. Specimen was the reassembled and leaked checked. No leaks were detected. A complete functional test was performed satisfactory.

5.4 TEST DATA

5.4.1 The averaged values of the data recorded during the test are presented in table 5-2.

5.4.2 Pressure drop versus flowrate is presented graphically in figure 5-5.

5.4.3 Functional test data taken after the flow test are presented in table 5-3. With 6000 psig pressure applied to the outlet port the leakage was uncontrollable.

Table 5-1. Flow Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Annin Company	A5094	62554-1	2-inch, 6000 psig check valve
2	Air Supply.		NA	NA	0 to 3000 psig
3	Hand Valve	Combination Pump & Valve Corp	PL-63	NA	1/2-inch
4	Filter	Bendix	1731261	NA	10-micron
5	Pressure Gage	Ashcroft	1057 S	NA	0-to 5000-psig
6	Regulator	Tescom	261201-114	NA	0-to 4000-psig
7	Pressure Gage	Ashcroft	1057 S	NA	0-to 5000-psig
8	Relief Valve	Anderson Green-wood	3TS44-2	16057	1500-psig
9	Check Valve	Crissair	2C5758	NA	3/4-inch
10	Water Tank	CCSD	NA	105471	666-gallon
11	Hand Valve	Marsh Instrument	1924	NA	3/4-inch
12	Check Valve	Crissair	2C5758	NA	3/4-inch
13	Relief Valve	Anderson Green-wood	3TS44-2	15734	100-psig
14	Hand Valve	Jenkins Bros	46U	NA	1/2-inch
15	Water Supply	NOPSI	NA	NA	
16	Pressure Gage	Ashcroft	1850	95-1209B	0-to 3000-psig ±0.5% FS Cal date 12-10-66
17	Hand Regulator	Vacco	MV6P4G32G	5116-18	1/2-inch
18	Hand Regulator	Vacco	NVA6P404S	19-90794	1-inch
19	Pressure Gage	Heise	NA	95-1569B	0-to 1500-psig ±0.5% FS Cal date 12-10-66
20	Differntial Pressure Gage	Meksler	NA	95-1189B	0-to-30-psig ±0.5% FS Cal date 12-10-66
21	Orifice	CCSD	NA	NA	1.198 inch

Table 5-1. **Flow** Test Equipment List Continued

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
22	Pressure Gage	Heise	NA	93-1092C	0-to 1000-psig ± 0.1% FS Cal date 12-20-66
23	Pressure Gage	Heise	NA	95-1637B	0-to 100-psig ± 0.1% FS Cal date 12-22-66
24	Pressure Gage	Heise	NA	95-1083C	0-to 100-psig ± 0.1% FS Cal date 12-22-66
25	Temperature Probe	Honeywell	2T2M13P	NA	Copper/Constantan
26	Temperature Recorder	Westronics	- NA	019461	-100 to +400°F Cal date 10-3-66

Table 5-2. **Flow** Test Data

FLOW (GPM)	SPECIMEN **PRESSURE**		TARE (PSID)	SPECIMEN PRESSURE DROP PSID(ΔP)	**MEDIA** TEMP-ERATURE (°F)
	UPSTREAM (PSIG)	DOWNSTREAM (PSIG)			
50	107.0	4.0	0.2	102.8	55
55	114.0	6.8	0.2	107.0	55
60	120.0	4.8	0.2	115.0	55
65	127.5	7.9	0.2	119.4	55
70	132.0	4.8	0.2	127.0	55
75	142.0	7.9	0.3	133.8	55
80	1520	7.9	0.3	143.8	55
88	163.0	8.0	0.3	154.7	55

Table 5–3. Functional Test Data Obtained After Flow

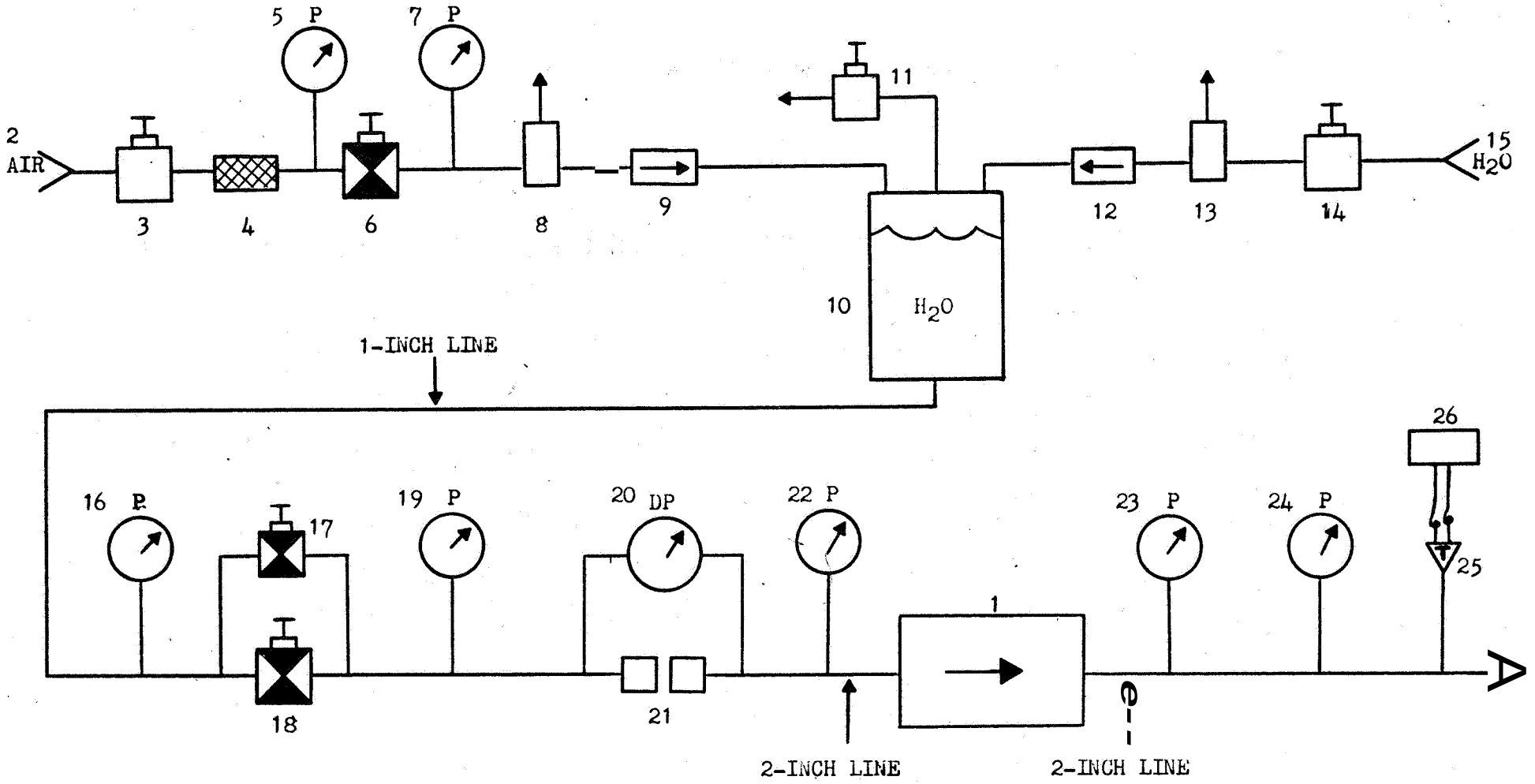
CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	0	NONE	150	105
2	6,000	NONE	255	180
3	6,000	UNCONTROL-LABLE		
4	6,000	UNCONTROL-LABLE		

Note: All pressure readings are in psig

Table 5–4. Functional Test After New Seals Were Installed

CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	0	NONE	60	48
2	6,000	NONE	60	55
3	6,000	NONE	57	55
4	6,000	NONE	53	52

Note: All pressure readings are in psig



NOTE: All lines ¼-inch unless otherwise indicated.
Refer to table 5-1 for item indentification.

Figure 5-1. Flow Test Schematic

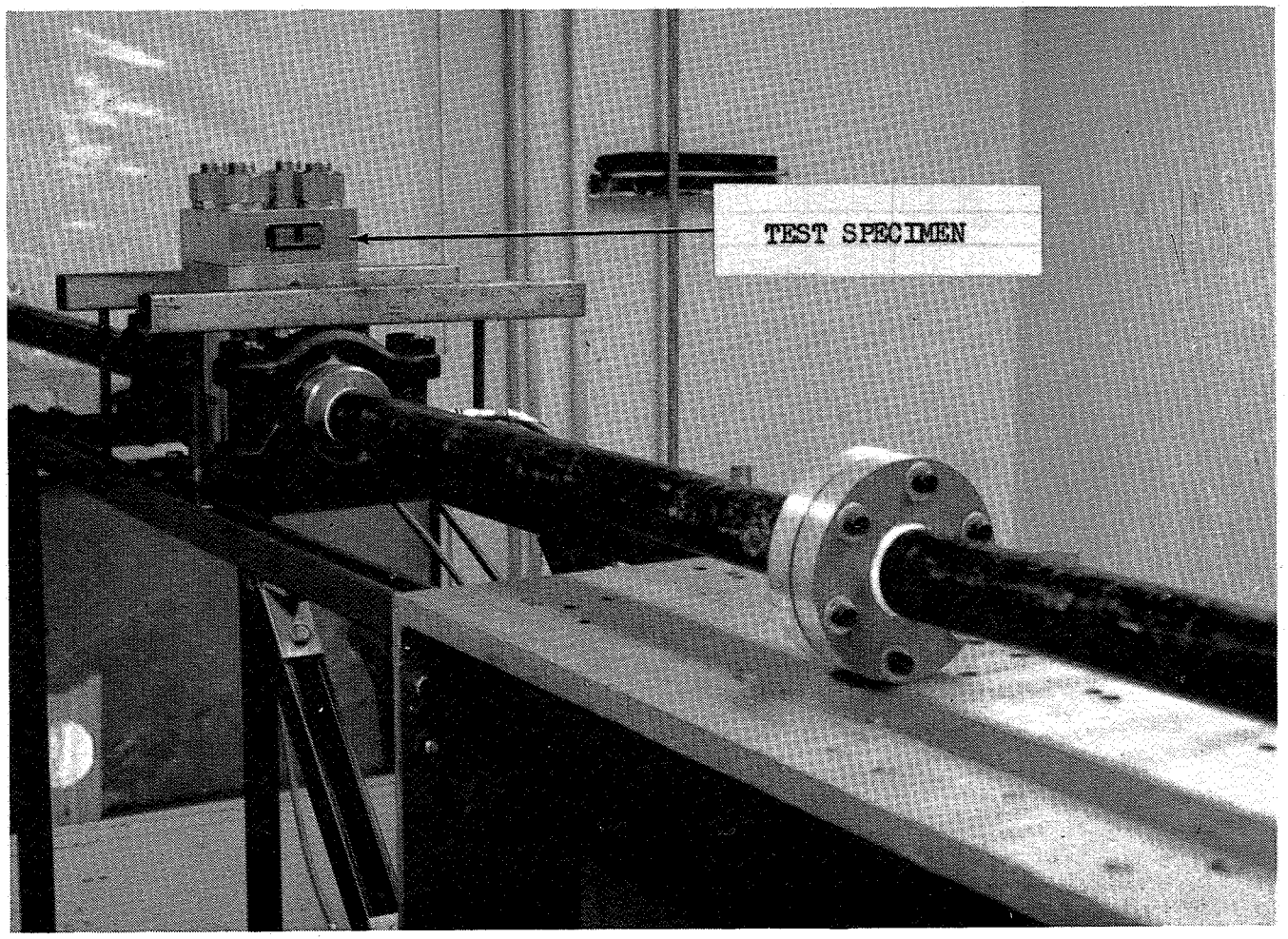


Figure 5-2. Flow Test Setup

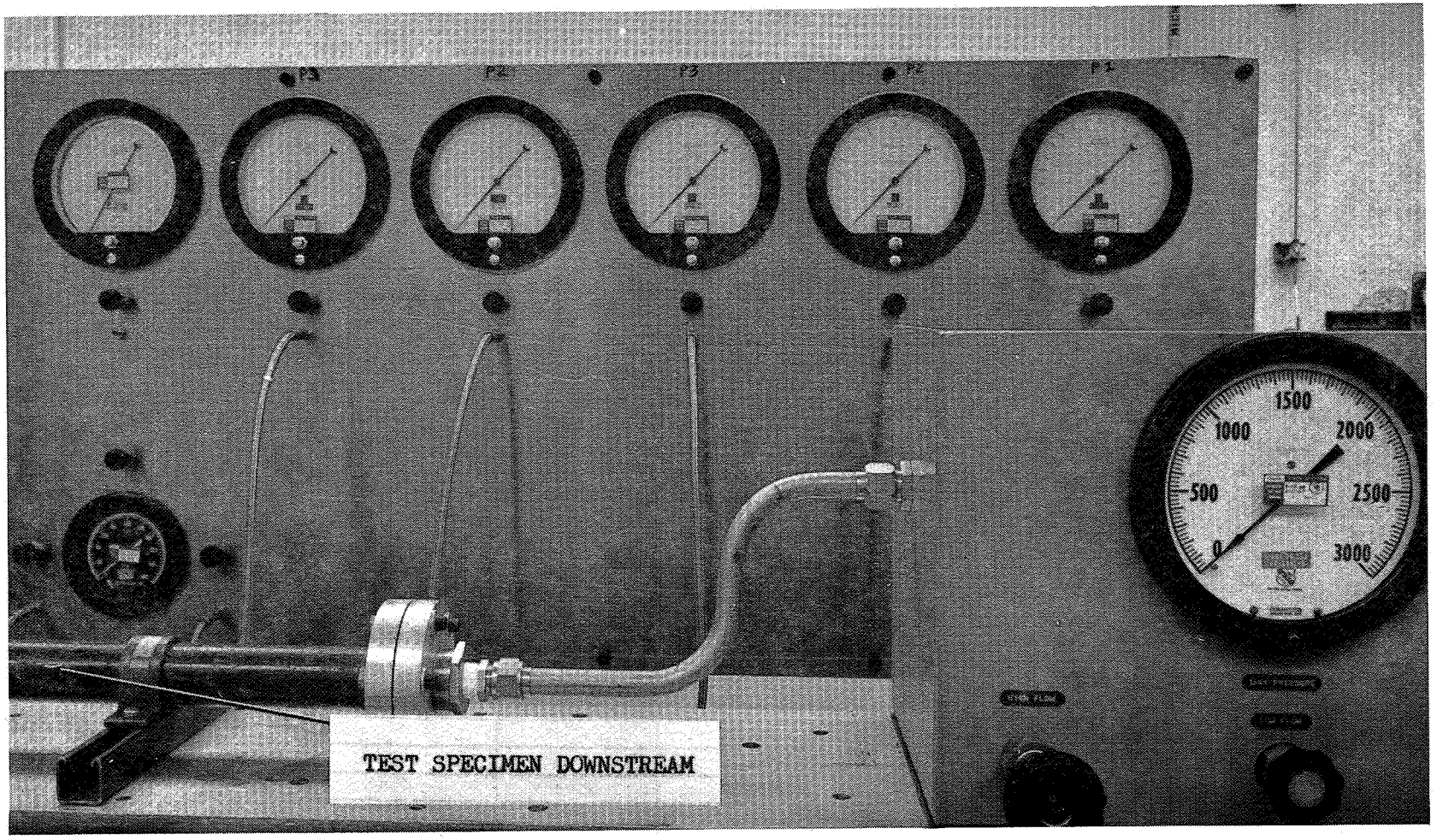


Figure 5-3. Flow Test Setup

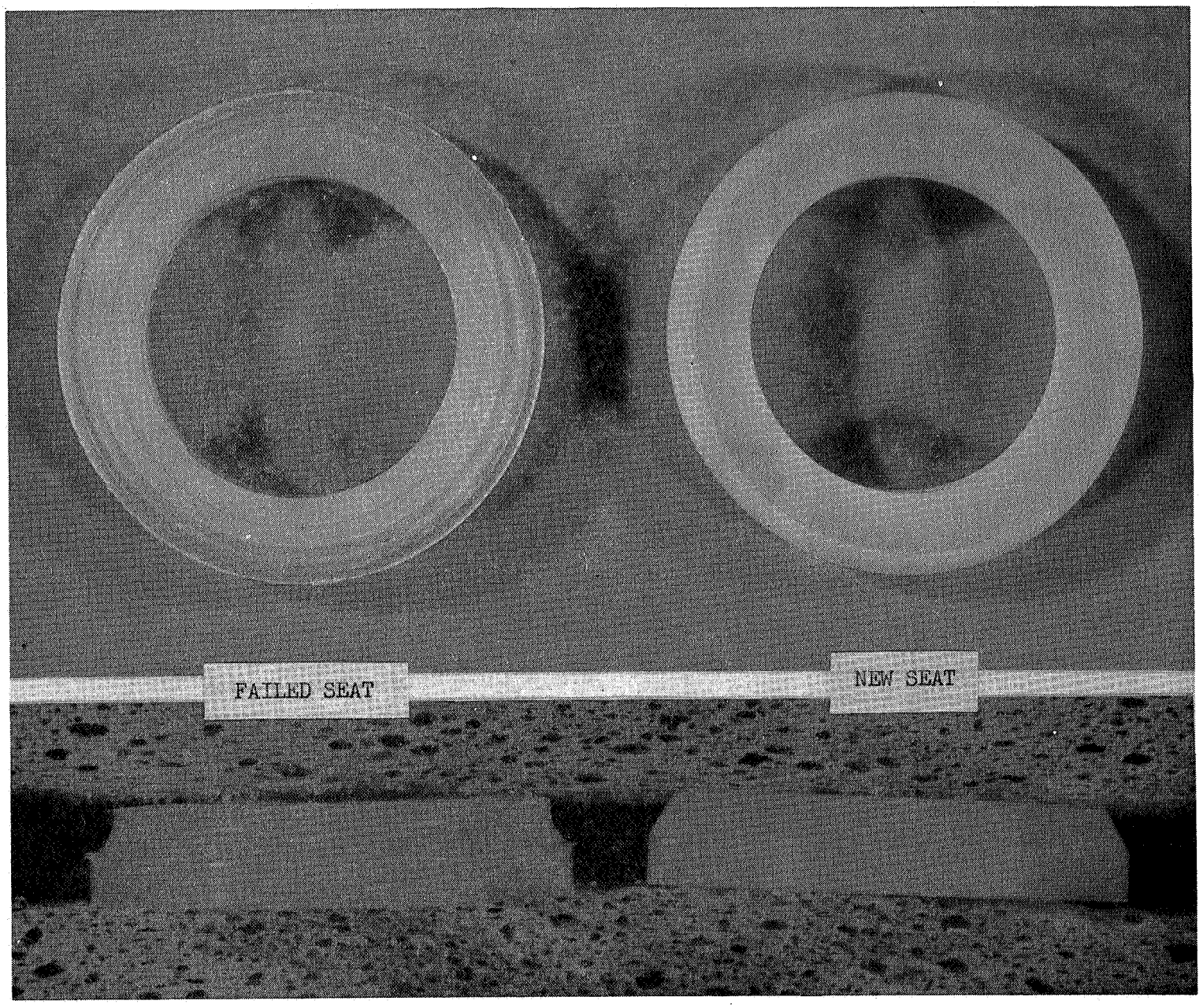


Figure 5-11. Post Flow Test Failure

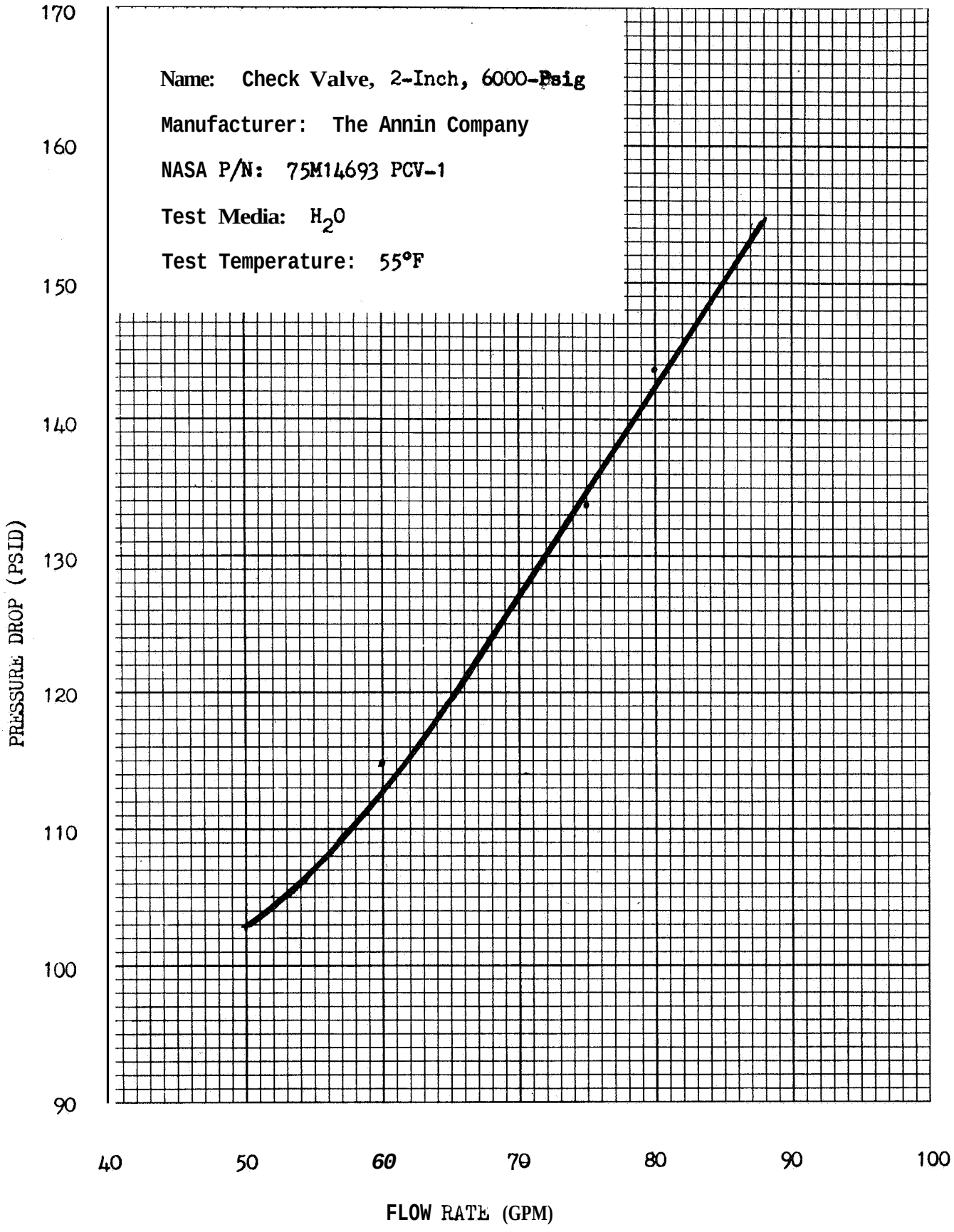


Figure 5-5. Pressure Drop Versus Flowrate Across Check Valve

SECTION VI

SURGE TEST

6.1 TEST REQUIREMENTS

6.1.1 The test specimen shall be subjected to 25 pressure surges at each port. A pressure surge shall consist of pressurizing one port of the specimen from zero psig to 6000 psig in 100 milliseconds.

6.1.2 GN_2 shall be used as the test medium.

6.2 TEST PROCEDURE

6.2.1 The test setup was assembled as shown in figure 6-1A and 6-2, using the equipment listed in table 6-1.

6.2.2 It was determined that all connections were tight, gages were installed and operating properly. All hand valves and regulator 6 were closed.

6.2.3 Hand valve 3, control valve 7, and solenoid valve 8 were opened, and hand valve 11 was cracked. The specimen was pressurized with GN_2 to 6,000 psig by adjusting regulator 6 and the pressure was monitored by means of transducer 9. Solenoid valve 8 was closed.

6.2.3.1 Solenoid valve 8 was opened and the specimen was pressurized to 6,000 psig. Solenoid valve 8 was closed and recording oscillograph 10 was monitored.

6.2.3.2 Valve 7 was adjusted and the procedure described in 6.2.3.1 was repeated until the recording oscillograph 10 indicated a pressure surge of zero psig to 6,000 psig within 100 milliseconds.

6.2.3.3 25 cycles were performed as described in 6.2.3.1.

6.2.4 The specimen was installed as shown in figure 6-1B.

6.2.4.1 The test was performed as described in 6.2.2 through 6.2.3.3.

6.2.5 A functional test as described in par 41 was performed.

6.3 TEST RESULTS

6.3.1 The pressurization rate for the 50 cycles ranged between 80 and 90 milliseconds. No leakage was observed during the post surge test functional test.

6.4 TEST DATA

6.4.1 A typical surge test waveform is shown in figure 6-3.

6.4.2 Functional test data recorded after the surge test are presented in table 6-2.

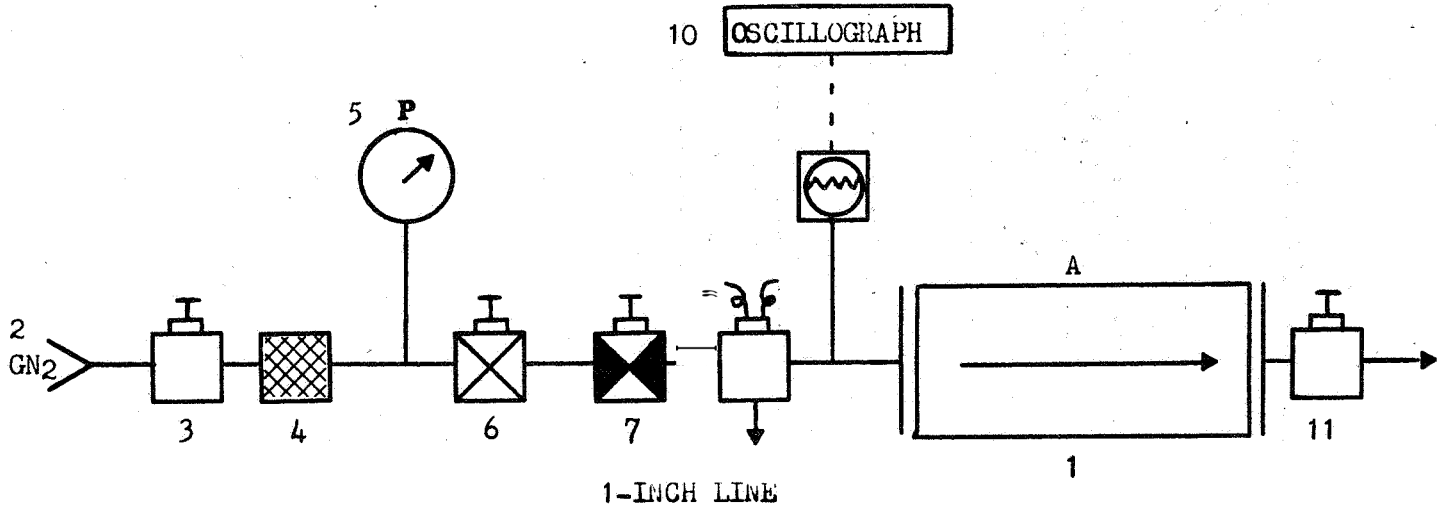
Table 6-1. Surge Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Annin Co.	45094	62554-1	2-inch, 6000-psig check valve
2	Pressure Source		NA	NA	GN_2 0-to 10,000-psig
3	Hand Valve	Hoke	101	NA	¼-inch bar stock
4	Filter	Microporous	813F-2D	NA	10-micron
5	Pressure Gage	Ashcroft	NA	200594P	0-to 10,000-psig ± 0.5% FS Cal date 12-10-66
6	Pressure Regulator	Tescom	6-1002	1009	0-to 10,000-psig inlet 0-to 10,000-psig outlet
7	Control Valve	Hoke	105	NA	1-inch, flow regulating
8	Solenoid Valve	Marotta	MU583-H	913	½-inch, 3-way
9	Transducer	Teledyne	76	652137	±0.5% accuracy
10	Oscillograph	CEC	5-124	012589	Recording
11	Hand Valve	Republic	56-4SS1	NA	¼-inch bar stock

Table 6–2. **Post** Surge Functional Test

CYCLE NO.	OUTLET PRESSURE;	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	*6,000*	NONE	64	58
2	6,000	NONE	64	58
3	6,000	NONE	67	58

Note: **All** pressure readings are in **psig**



NOTE: All lines ¼-inch unless otherwise indicated.
Refer to table 6-1 for item identification.

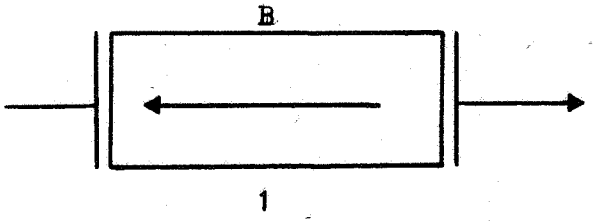


Figure 6-1. Surge Test Schematic

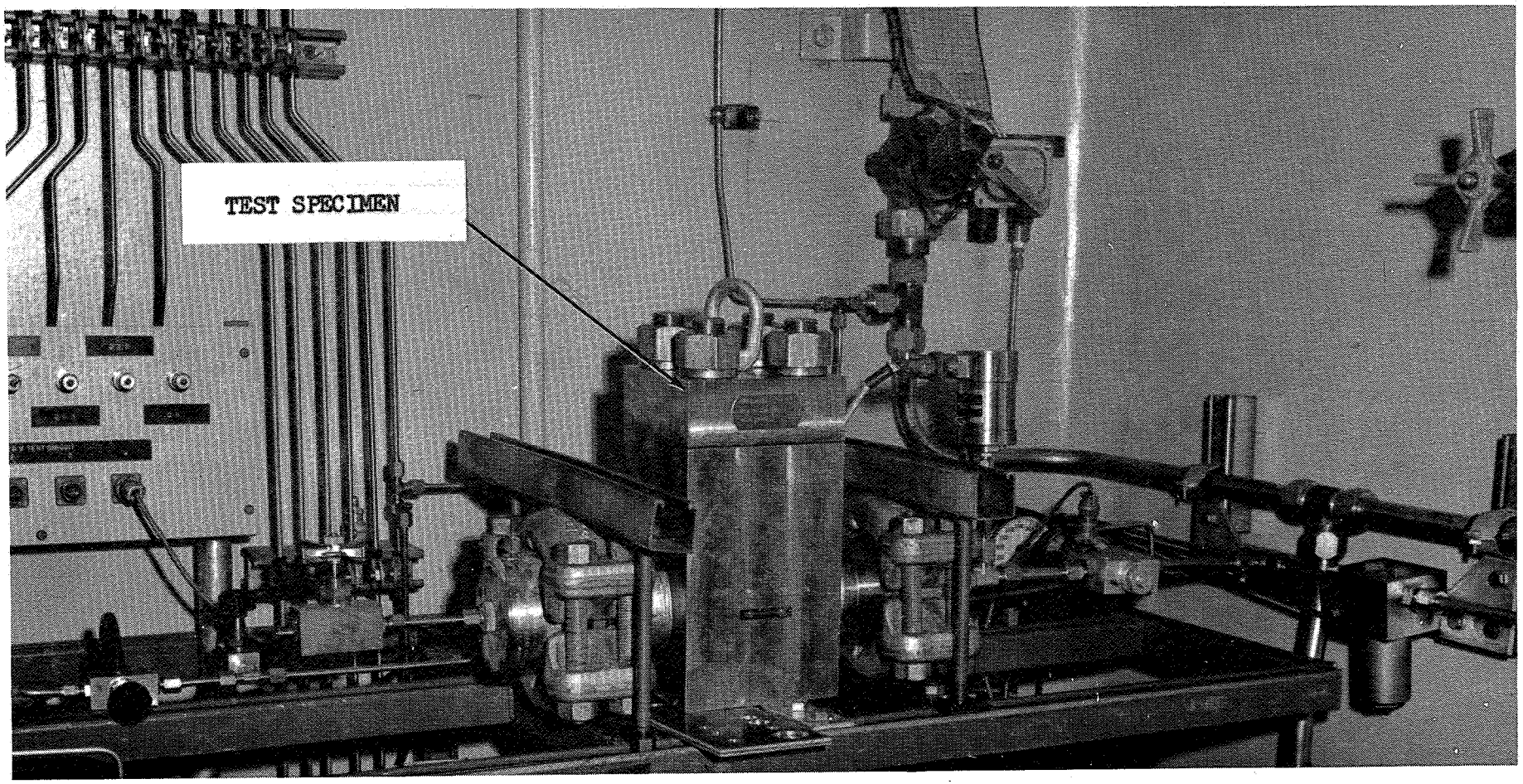


Figure 6-2. Surge Test Setup

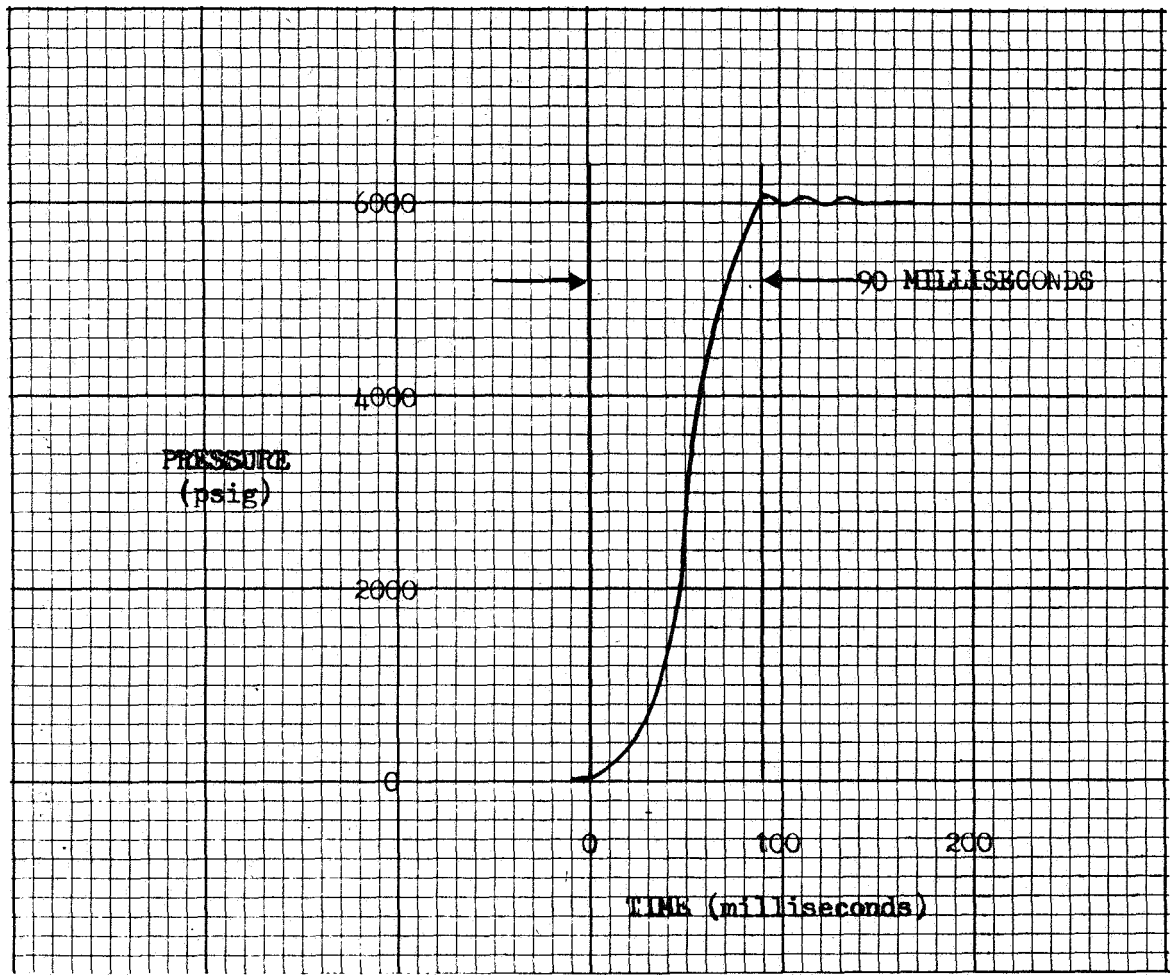


Figure 6-3. Typical Surge Waveform

SECTION VII

LOW TEMPERATURE TEST

7.1 TEST REQUIREMENTS

7.1.1 The test specimen shall be subjected to a low temperature test of -20(+0, 04)°F to determine whether the environment causes degradation or deformation.

7.1.2 A functional test as prescribed in section IV shall be performed during this test with the following exceptions. The specimen will not be submerged in water. Leakage will be monitored by noting pressure drop.

7.2 TEST PROCEDURE

7.2.1 The test specimen was placed in a low temperature chamber and installed as shown in figure 4-1 installation A using the equipment listed in table 4-1. Figure 7-1 also shows the test setup.

7.2.2 The chamber was controlled to the specified test conditions, and a relative humidity between 60 and 90 per cent was maintained.

7.2.3 A functional test (refer to paragraph 4.1) was performed when temperature stabilization was obtained.

7.2.4 The chamber temperature was returned to ambient conditions upon completion of the functional test.

7.2.5 The test specimen was visually inspected and functionally tested within 1 hour following the return to ambient conditions.

7.3 TEST RESULTS

Results of the low temperature test and associated functional tests were satisfactory. No leakage was detected.

7.4 TEST DATA

Test data recorded during and after the low temperature test are presented in tables 7-1 and 7-2 respectively.

Table 7-1. Functional Test Data Obtained During Low Temperature Test

CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	56.5	21.5
2	6,000	NONE	56.0	22.5
3	6,000	NONE	53.5	24.0

Note: All pressure readings are in psig

Table 7-2. Functional Test Data Obtained After Low Temperature Test

CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	57	45
2	6,000	NONE	56	44
3	6,000	NONE	57	47

Note: All pressure readings are in psig

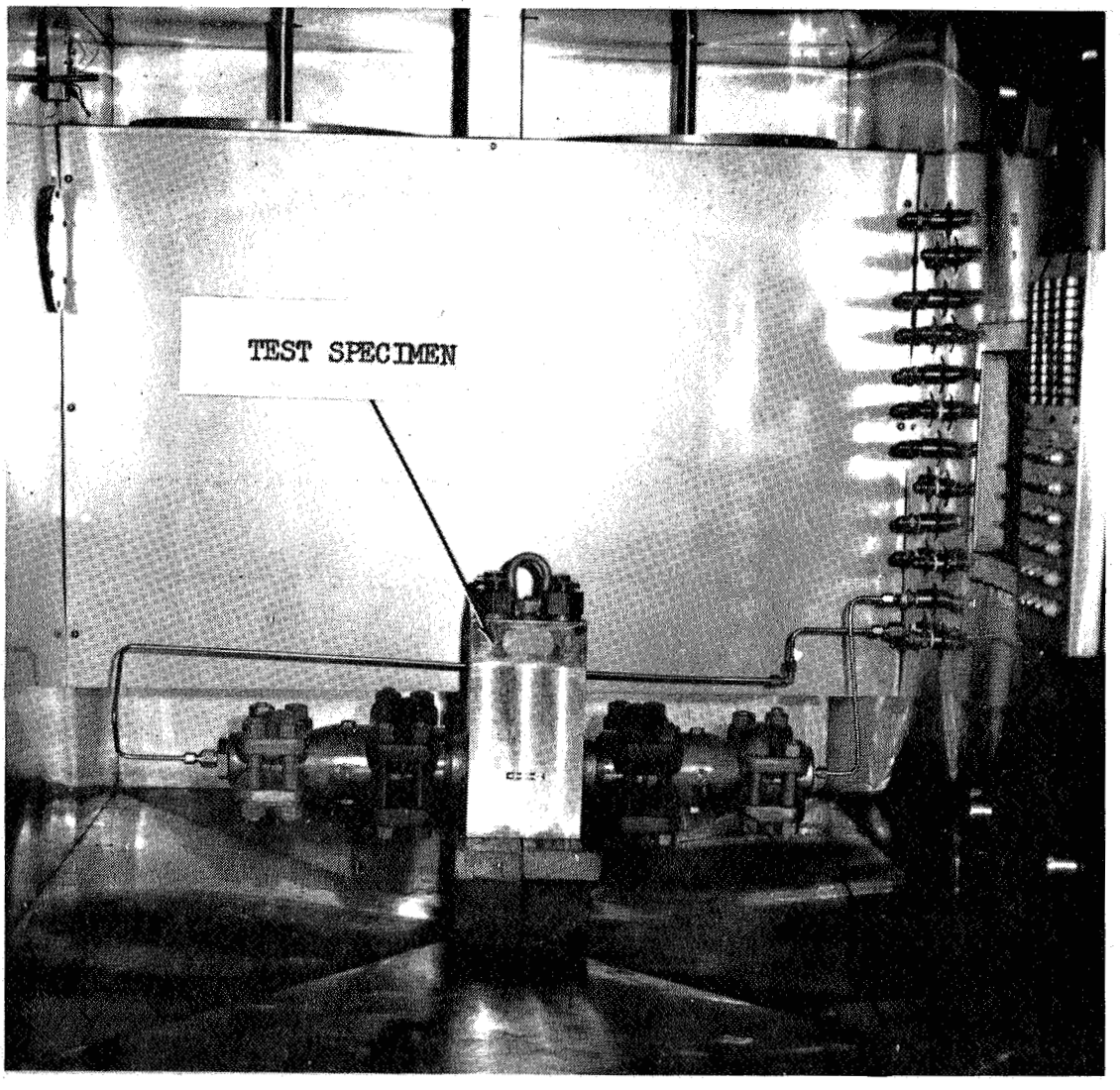


Figure 7-1. Low And High Temperature Test Setup

SECTION VIII

HIGH TEMPERATURE TEST

8.1 TEST REQUIREMENTS

8.1.1 The test specimen shall be subjected to a high temperature test of +160 (+4, -0)°F to determine whether the environment causes degradation or deformation.

8.1.2 A functional test shall be performed during this test.

8.2 TEST PROCEDURE

8.2.1 The test specimen was placed in a high temperature chamber and installed as shown in figure 4-1 installation A *using* the equipment listed in table 4-1. Figure 7-1 also shows the test setup.

8.2.2 The chamber was controlled to the specified test conditions, and a relative humidity of 20 (±5) per cent was maintained.

8.2.3 A temperature of +160 (+4, -0)°F was maintained for a period of 72 (+2, -0) hours.

8.2.4 A functional test was conducted while the chamber temperature was maintained.

8.2.5 The chamber temperature was returned to ambient conditions upon completion of the functional test.

8.2.6 The specimen was visually inspected and functionally tested within 1 hour following the establishment of ambient conditions.

8.3 TEST RESULTS

The results of the high temperature test and associated functional tests were satisfactory. No leakage was detected.

8.4 TEST DATA

Data recorded during and after high temperature testing are presented in tables 8-1 and *8-2* respectively.

Table **8-1.** Functional Test Data Obtained During **High** Temperature Test

CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	95	63
2	6,000	NONE	70	35
3	6,000	NONE	71	37
4	6,000	NONE	70	35

Note: All pressure readings are in **psig**

Table 8–2. Functional Test Data Obtained After High Temperature Test

CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	55	7
2	6,000	NONE	65.5	5
3	6,000	NONE	65	3

Note: All pressure readings are in psig

SECTION IX

CYCLE TEST

9.1 TEST REQUIREMENTS

9.1.1 The inlet port of the test specimen shall be slowly pressurized from zero psig to 6000 psig and back to aero psig. This shall constitute 1 cycle. The test specimen shall be cycled 1000 times,

9.1.2 A functional test as specified in section IV shall be performed following the completion of 50, 100, 500, and 1000 cycles.

9.1.3 GN_2 shall be used as the test medium.

9.2 TEST PROCEDURE

9.2.1 The test setup was assembled as shown in figure 9-land 9-2 using the equipment listed in table 9-1.

9.2.2 It was determined that all connections were tight, gages were installed and operating properly. All valves and regulator 6 were closed.

9.2.3 Hand valve 3 was opened and control valve 9 was cracked. The inlet port of solenoid valve 8 was pressurized with GN_2 to 6000 psig by adjusting regulator 6. The pressure was monitored using gage 7.

9.2.3.1 Solenoid valve 8 was opened and the inlet port of the specimen was pressurized to 6000 psig. The pressure was monitored using gage 10.

9.2.3.2 The upstream and downstream sides of the specimen was vented to zero psig by closing solenoid valve 8 and opening solenoid valve 12. The pressure monitored by means of gages 10 and 11. Solenoid valve 12 was closed.

9.2.4 The specimen was cycled 1000 times as described in 9.2.3.1 and 9.2.3.2.

9.2.5 A functional test was performed as specified in section IV following the completion of 50, 100, 500, and 1000 cycles.

9.3 TEST RESULTS

9.3.1 During the cycle test the cracking pressure of the specimen increased as the number of the cycles increased, During the post 1000 cycle functional test the specimen cracked at 250 psig. The normal cracking pressure was 55 psig.

9.3.2 The cause of the increased cracking pressure was the scoring of the poppet and poppet bushing due to lack of lubrication of these components, as was found during inspection after life cycle.

9.3.3 During disassembly the brass bushing was found to be stuck in the specimen houseing and the poppet was stuck in the bushing. A Dillion force gauge was arranged to check the extent of sticking of the poppet in the bushing. A force of 12 inch pounds was required to slide the poppet out of the bushing, this accounted for the erratic cracking pressures.

9.4 TEST DATA

Test data are presented in tables 9-2 through 9-6.

Table 9-1. Cycle Test Equipment List

tem No.	Item	Manufacturer	-Yodel/ 'art No.	Serial No.	Remarks
1	Test Specimen	Annin Co.	A5094	52554-1	2-inch, 6000-psi check valve
2	Pressure Source		NA	NA	0-to 10,000-psig GN_2
3	Hand Valve	Hoke	G101	NA	$\frac{1}{4}$-inch bar stock
4	Filter	Fiuid Dynamics	FL02-888	4Q66	10-micron
5	Press-we Gage	Ashcroft	NA	95-1648	0-to 10,000-psig ± 0.5% FS Cal date 12-15-66
6	Pressure Regulato	Tescom	26-1 0224	8360	0-to 10,000-psig inlet 0-to 10,000-psig outlet
7	Pressure Gage	Ashcroft	NA	95-1647	0-to 10,000-psig ±
8	Solenoid Valve	Marrota	232224		
9	Control Valve	Republic	156-4SS1	NA	$\frac{1}{4}$-inch, flow regulating
10	Pressure Gage	Heise	H35227	012452	0-to 10,000-psig ± 0.1% FS Cal date 3-8-67
11	Pressure Gage	Heise	H34955	014321	0-to 10,000-psig ± 0.1% FS Cal date 1-10-67
12	Solenoid Valve	Marotta	232224	109	$\frac{1}{4}$-inch
13	Timer	G.C. Wilson & Co,	M-1	NA	110-vac

Table 9-2. Pre-Cycle Functional Test Data

CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	58	47
2	6,000	NONE	55	47
3	6,000	NONE	54.5	46
4	6,000	NONE	55	46

Note: All pressure readings are in psig

Table 9-3. Functional Test Data Obtained After 50 Cycles

CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	52	45
2	6,000	NONE	54	45.5
3	6,000	NONE	55	45
4	6,000	NONE	54	45.5

Note: All pressure readings are in psig

Table 9-4. Functional Test Data Obtained After 100 **Cycles**

'CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	100	15
2	6,000	NONE	175	10
3	6,000	NONE	75	7
4	6,000	NONE	125	5

Note: **All** pressure readings are in **psig**

Table 9-5. Functional Test Data Obtained After 500 Cycles

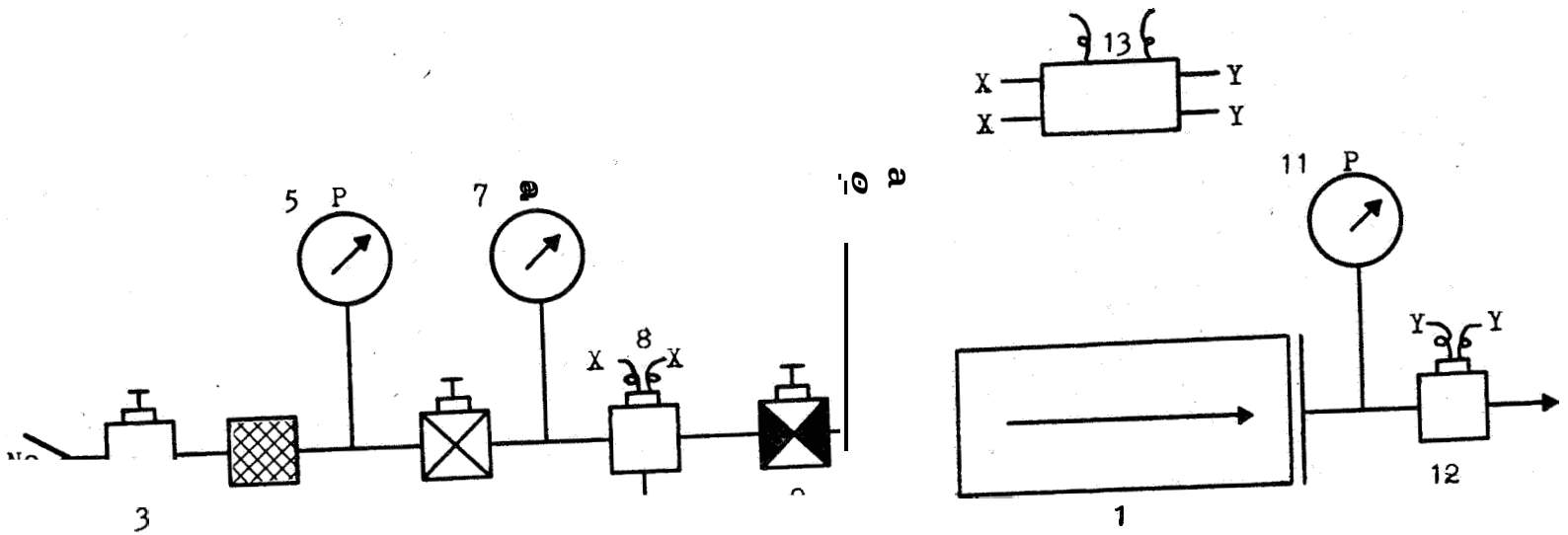
CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	100	35
2	6,000	NONE	120	35
3	6,000	NONE	115	40
4	6,000	NONE	115	37

Note: All pressure readings are in psig.

Table 9-6. Functional Test Data Obtained After 1000 Cycles

CYCLE NO.	OUTLET PRESSURE	LEAKAGE	CRACKING PRESSURE	RESEAT PRESSURE
1	6,000	NONE	125	100
2	6,000	NONE	150	125
3	6,000	NONE	175	150
4	6,000	NONE	200	175
5	6,000	NONE	225	200
6	6,000	NONE	250	225

Note: All pressure readings are in psig



NOTE: All lines ¼-inch.
Refer to table 9-1 for item identification.

Figure 9-1. Cycle Test Schematic

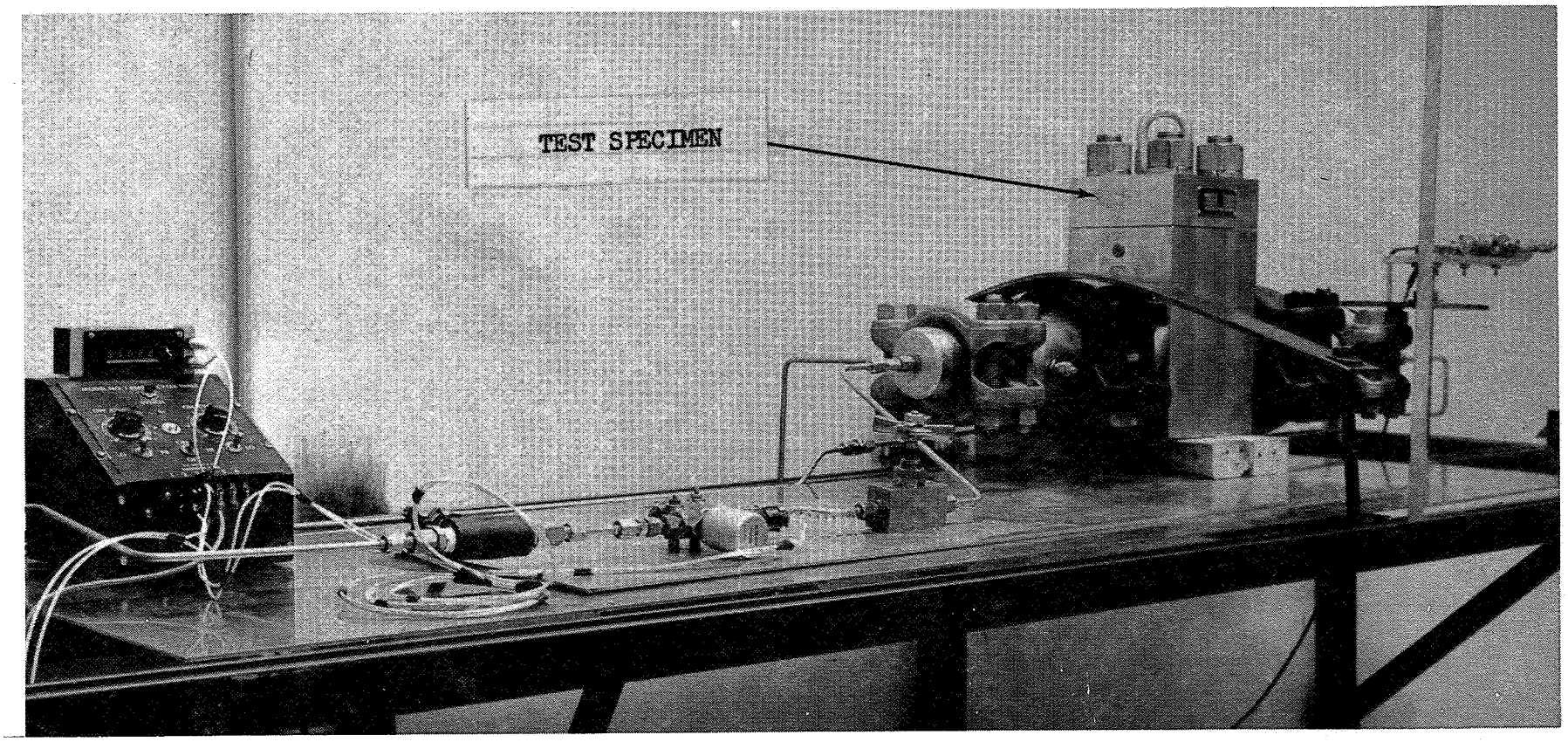


Figure 9-2. Cycle Test Setup

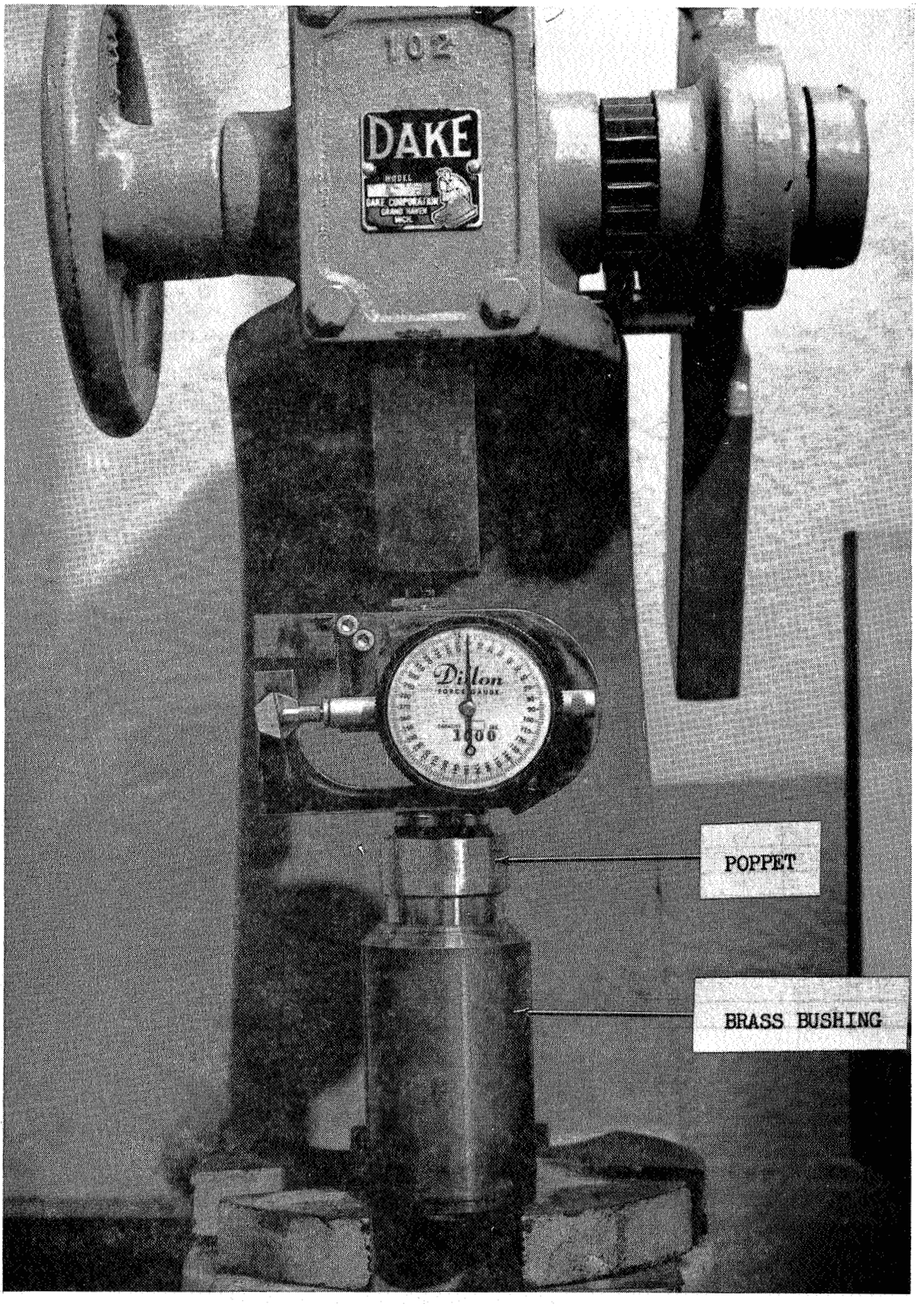


Figure 9-3. Setup Used To Check The Extent Of Poppet Sticking

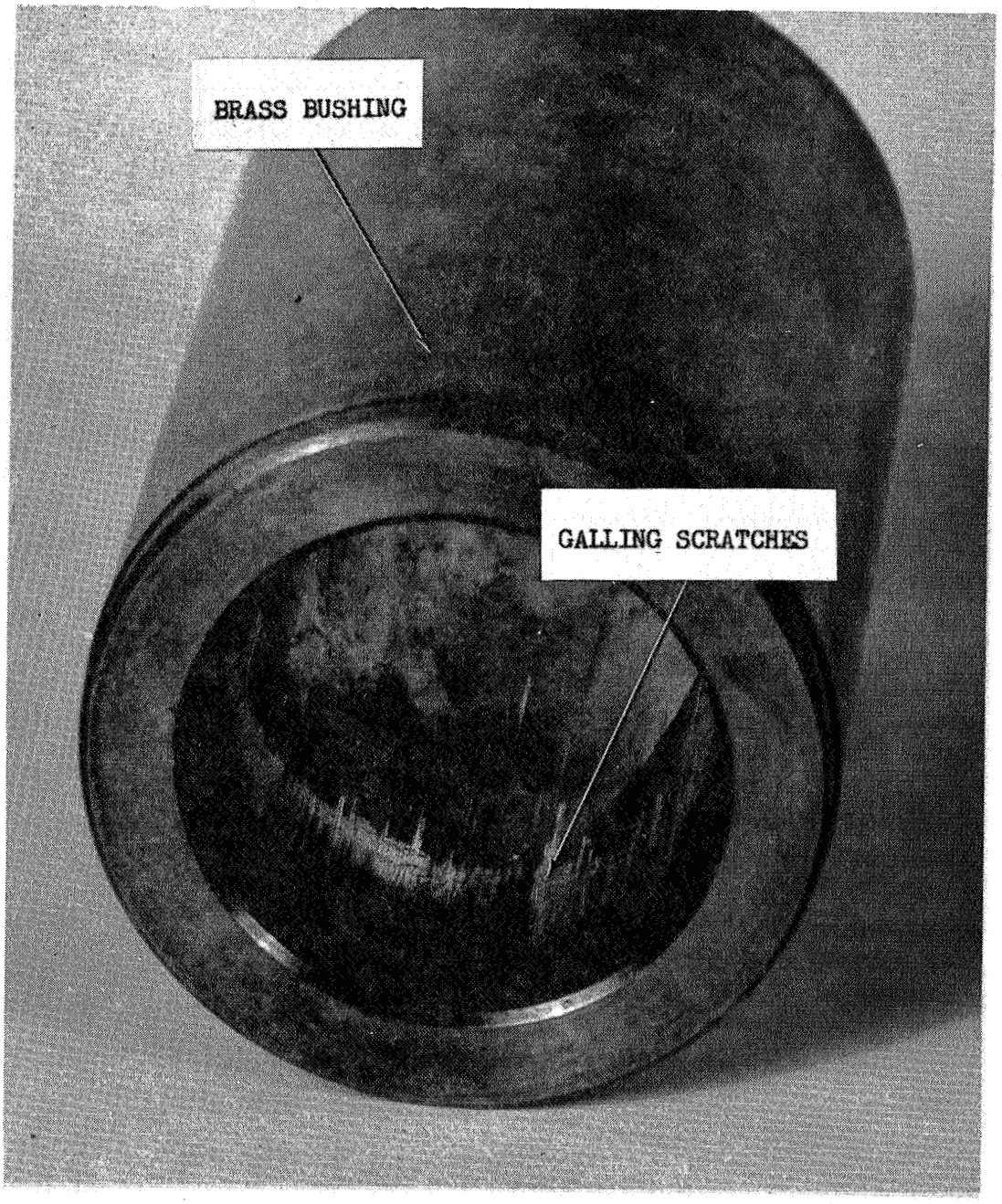


Figure 9-4. Failure After 1000 Cycles

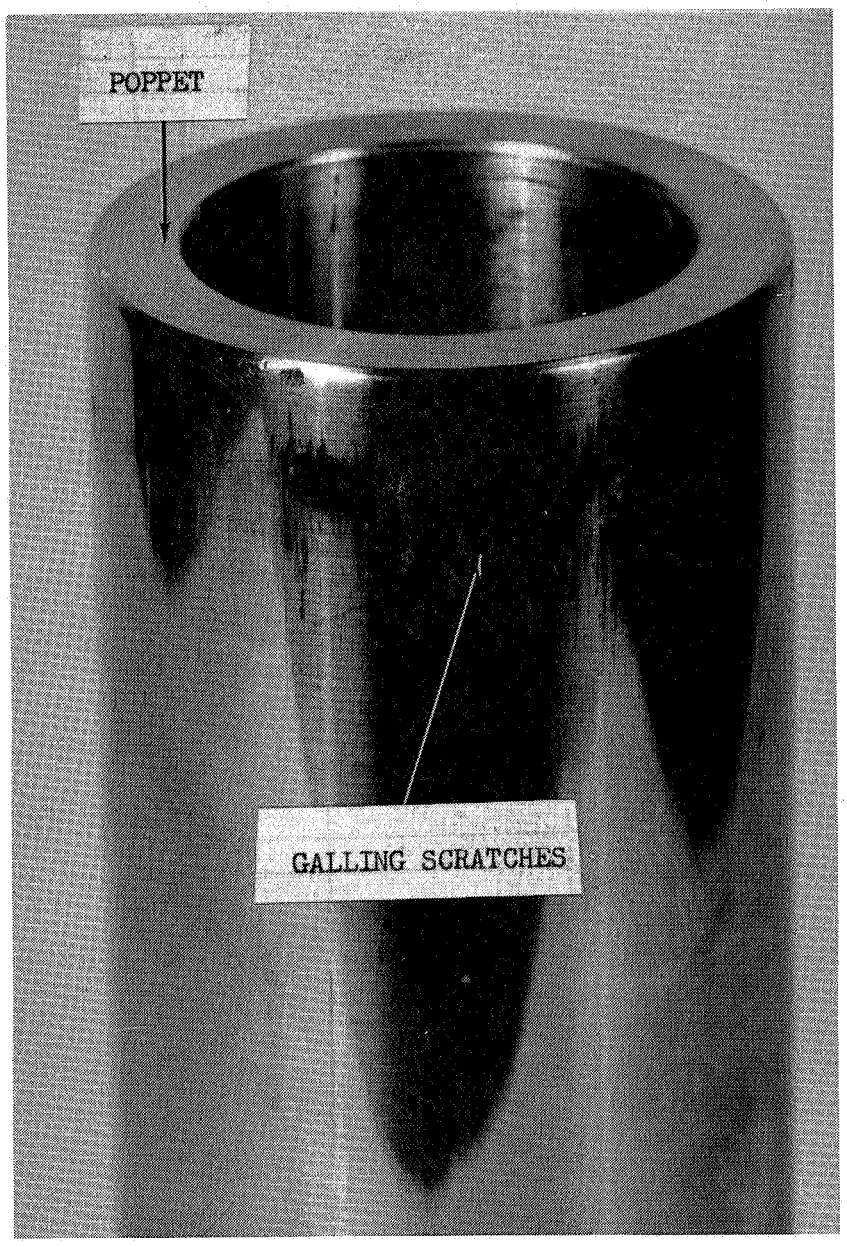


Figure 9–5. Failure After 1000 Cycles

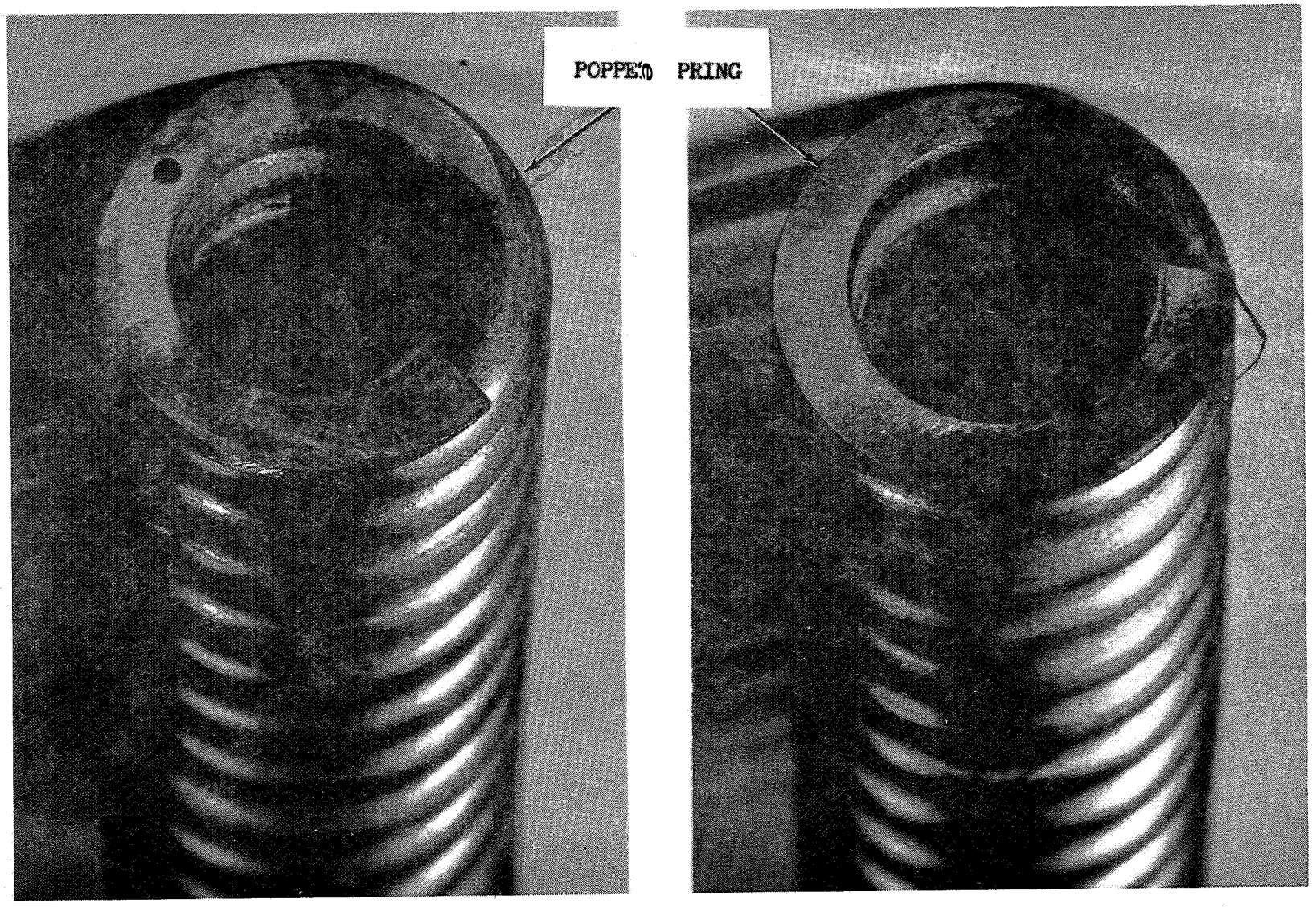


Figure 9-6. Failure After 1000 Cycles

SECTION X

BURST TEST

10.1 TEST REQUIREMENTS

10.1.1 The inlet and outlet ports of the test specimen shall be simultaneously pressurized to 24,000 psig. This pressure shall be maintained for 5 minutes.

10.1.2 The test specimen shall be checked for leakage and distortion.

10.1.3 Water shall be used as the test medium.

10.2 TEST PROCEDURE

10.2.1 The test setup was assembled as shown in figure 10-1 and figure 10-2, using the equipment listed in table 10-1.

10.2.2 It was determined that all connections were tight, gages were installed and operating properly, and all valves were closed.

10.2.3 Hand valves 4 and 6 were opened,. and the system'and specimen was flooded with water by operating pump 3.

10.2.3.1 Hand valve 6 was closed and the specimen was pressurized to 21,500 psig at which failure occurred.

10.3 TEST RESULTS

10.3.1 Specimen failure occurred at 21,500 psig. The valve "U" seal. sealing the head to the body failed, and the specimen began to leak at a rate of approximately 100 psi per second.

10.4 TEST DATA

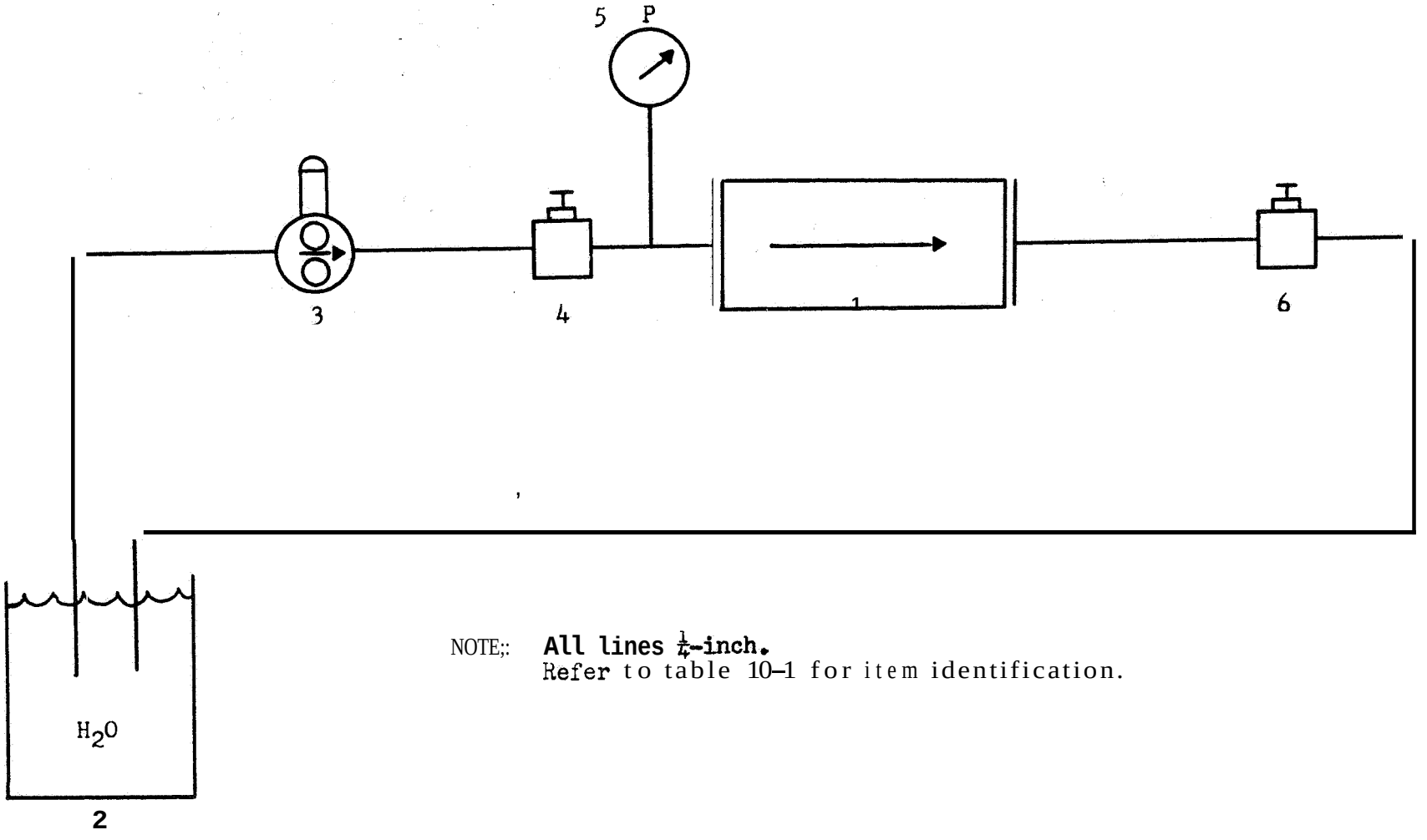
10.4.1 Data recorded during the burst test are presented in table 10-2.

Table 10-2. Burst Test Data

Pressure Failure Occurred	21,500 psig
Leakage	100 psi per second

Table 10-1. **Burst** Test Equipment List

Item a.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Annin Co.	A5094	62554-1	2-inch, 6000-psig check valve
2	.eservoir	CSD	NA	NA	H_2O 2 gallon
3	lotor-Driven Pump	Sprague Eng.	NA	300-1664	0-to 36,000-psig
4	Hand Valve	Ioke	G101	NA	½-inch bar stock
5	'ressure Gage	Astra	NA	011893A	0-to 30,000-psig ±1.0% FS Cal. date 11-2-66
6	Hand Valve	Hoke	G101	NA	½-inch bar stock



NOTE:: **All lines ¼-inch.**
Refer to table 10–1 for item identification.

Figure 10–1. Burst Test Schematic

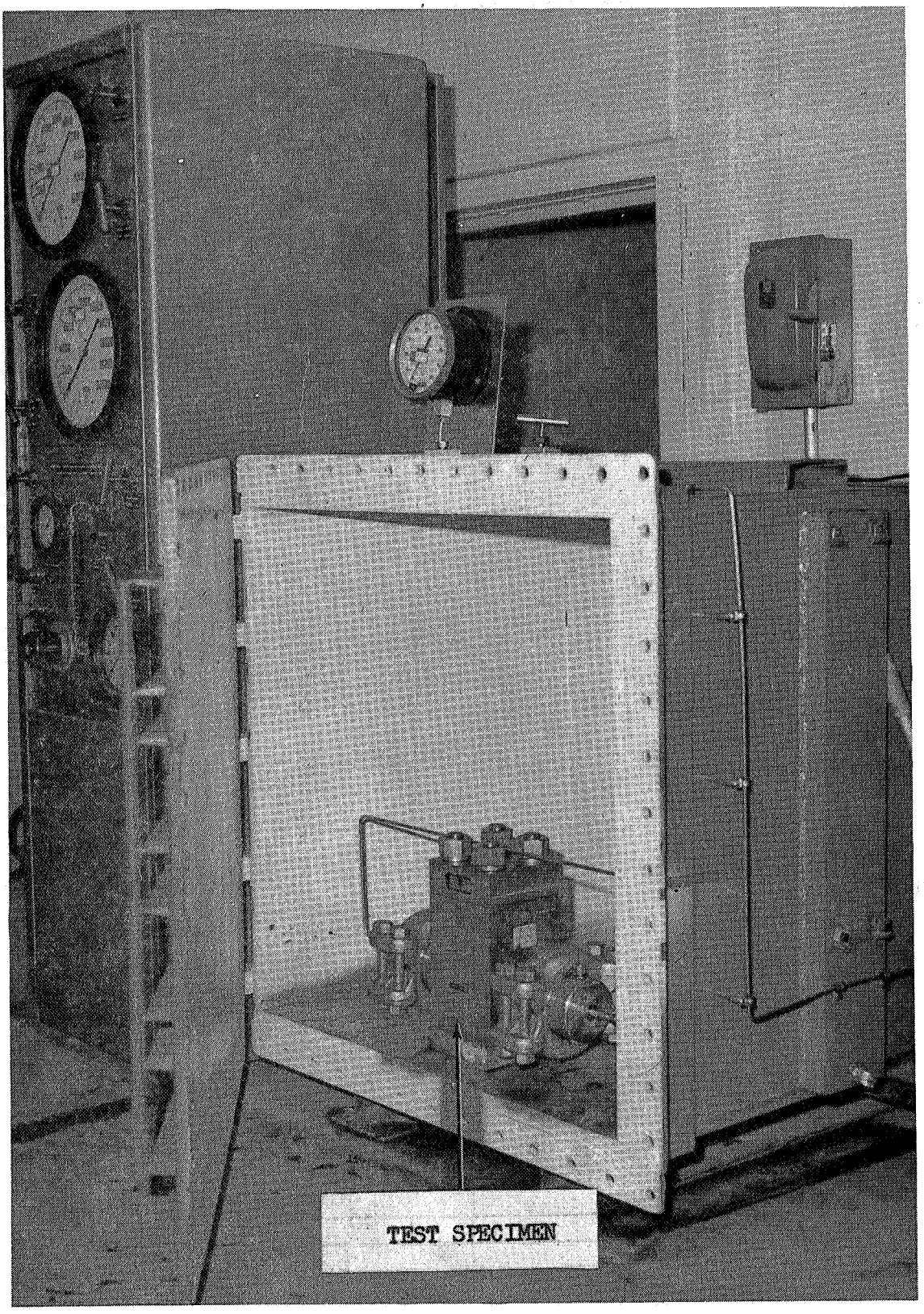


Figure 10–2. Burst Test Setup

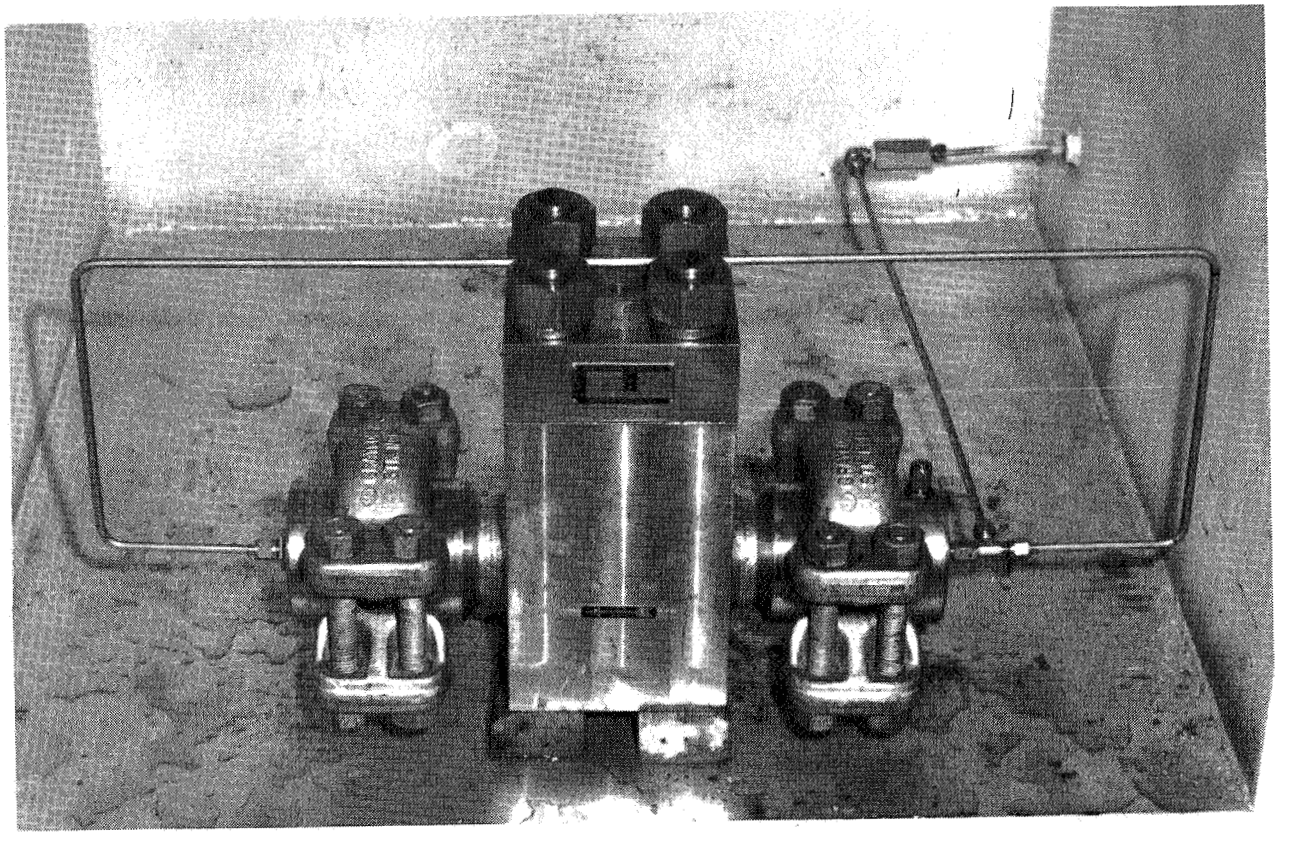


Figure 10-3. **Burst Test Setup**

APPROVAL

TEST REPORT

FOR

CHECK VALVE, 2-INCH, 6000-PSIG

The Annin Co. Drawing Number *A5094*

NASA Drawing Number 75M14693 PCV-1

SUBMITTED BY:

T.W. Sparks
Test and Evaluation Section

APPROVALS

R.W. Claunch
Program Supervisor

V.J. Venko, Director
Engineering Department

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